Research Product 87-31

Guidelines for Designing Courseware for the Computerized Hand-Held Instructional Prototype (CHIP)

Development Engineering Office
Training Research Laboratory

December 1987

U. S. Army Research Institute for the Behavioral and Social Sciences

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EDGAR M. JOHNSON
Technical Director

WM. DARRYL HENDERSON
COL, IN
Commanding

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Technical review by

Joan Harman
Douglas A. Ramsey

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This research presents guidelines for designing courseware for CHIP (Computerized Hand-held Instructional Prototype), an electronic training aid developed by the Army Research Institute. First, using the framework of instructional systems development, a method of selecting appropriate training content for CHIP is described. Next, a procedure is given for screening and planning a particular CHIP curriculum. Finally, an authoring tool that enables conversion of the curriculum to CHIP format is reviewed, (Continued)

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and other resources required for the conversion are discussed. Throughout the discussion, examples and lessons are drawn from five CHIP applications by the Army, Navy, and Air Force, which have undergone the process of selecting, planning, and converting curriculums to CHIP.

Research Product 87-31

Guidelines for Designing Courseware for the Computerized Hand-Held Instructional Prototype (CHIP)

Rebecca L. Oxford
O-C Associates, Inc.

V. Melissa Holland
Army Research Institute

L. Neil Goble
Technology Incorporated

Development Engineering Office
Robert A. Wisher, Chief

Training Research Laboratory
Jack H. Hiller, Director

U.S. ARMY RESEARCH INSTITUTE FOR THE BEHAVIORAL AND SOCIAL SCIENCES
5001 Eisenhower Avenue, Alexandria, Virginia 22333-5600

Office, Deputy Chief of Staff for Personnel
Department of the Army

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Education and Training Systems

FOREWORD

The Development Engineering Office of the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) is charged with developing innovative technologies for military training and job environments. One of the achievements of this office is the Computerized Hand-held Instructional Prototype (CHIP). CHIP is a notebook-sized training unit that contains a book for both text and graphics, a small screen for visual display, a speaker for audio output, a set of generic courseware for routines common across all applications, and replaceable cartridges for job-specific courseware. CHIP allows constant interaction between the student and the machine. Its routines are designed to be motivating and interesting to the learner. One of the objectives of this document is to provide guidelines for developing CHIP courseware by converting curriculum materials from the traditional, print-oriented format to the computerized CHIP format.

The development and testing of CHIP are part of a joint-service effort. Members of the CHIP Working Group represent three services separately (Air Force, Army, and Navy) and one tri-service school (Explosive Ordnance Disposal at Indian Head, Maryland). Current and recent Working Group members whose ideas have helped shape CHIP include the following: MSgt Ted Bailie and CPT Ron Joy, Air Force Military Training Center, Lackland Air Force Base, Texas; MAJ Thomas Ulrich, MAJ Stewart Monti, and CPT Bernard Asiu, Air Training Command, Randolph Air Force Base, Texas; LTC David L. Pohlman, AMD/RDST, Brooks Air Force Base, Texas; CW2 James Buchwald, CW3 George Rogaliner, and SFC Luther Biggers, Army Air Defense Artillery School, Ft. Bliss, Texas; James Dees and Talmadge Swallows, U.S. Army Ordnance Center and School, Aberdeen Proving Ground, Maryland; Dr. Virginia Pendergrass, Dr. Dennis Weller, and Anne Leopold, Naval Training Systems Center, Orlando, Florida; Patricia Risher, Training Development Unit, Naval Training Center, Orlando; QMCS(SS) Lynn Novinger and QM(SW) Stephen Sisung, Quartermaster "A" School, Naval Training Center, Orlando; Dr. Carol Robinson, Navy Personnel Research and Development Center, San Diego, California; LT Donald Garcia, MSG Carl Reynolds, CPT Robert Harris, and GYSgt James O'Neal, Naval Ordnance Station, Indian Head, Maryland; Dr. Robert Wisher and Dr. Melissa Holland, Development Engineering Office, U.S. Army Research Institute for the Behavioral and Social Sciences, Alexandria, Virginia; and Dr. Rebecca Oxford, O-C Associates, Inc., Alexandria, Virginia. The military proponent for CHIP is the Army Air Defense Artillery School, Ft. Bliss, Texas. Technology Incorporated (TI), Dayton, Ohio, is contracted to develop CHIP. CHIP Program Managers are Lloyd Neil Goble for TI and Dr. Melissa Holland for ARI. Additional information for this document was provided by Dr. Herbert Colle of Wright State University.

EDGAR M. JOHNSON
Technical Director

GUIDELINES FOR DESIGNING COURSEWARE FOR THE COMPUTERIZED HAND-HELD INSTRUCTIONAL PROTOTYPE (CHIP)

EXECUTIVE SUMMARY

Requirement:

To present guidelines for designing courseware for the Computerized Hand-held Instructional Prototype (CHIP).

Procedure:

This book of guidelines was created through the following procedures. First, the CHIP Working Group developed a set of common, cross-application, cross-service definitions of terms to be used in curriculum conversion (from traditional book format to CHIP format). Second, curriculum screening and courseware planning sheets were devised by the Working Group to aid in the conversion. Third, the Working Group established a structure and a process for sharing ideas with group members and with the government-funded CHIP developer. Fourth, documents relevant to the development of instructional systems and computer-assisted instruction were reviewed. Finally, the first author conducted semistructured interviews with other Working Group members concerning such topics as kinds of curriculum materials useful for conversion to CHIP format, purposes for using CHIP in various military settings, and personnel and other resources required for developing CHIP courseware.

Findings:

CHIP is most useful for drill and practice in training step-by-step procedures, technical terminology, and job-related facts. CHIP is valuable for refreshing or sustaining prior training; for supplementing initial training through remediation, make-up, and enhancement; or for correspondence course training ("distance training"). It can be used in the classroom, on the job, at home, or in "lull time" situations. CHIP courseware is developed by converting selected curriculum materials from existing book-based format to computerized format. Certain technical capabilities are required for the development of CHIP courseware, but the CHIP authoring aid will make courseware development fairly simple.

Utilization of Findings:

CHIP has a wide variety of potential applications for job-related training and basic skills improvement within the military. Although this document describes military uses, CHIP also holds promise for use in business, industry, government, and public schools. The guidelines provided here will help potential users determine whether CHIP can be used for their particular purposes and how CHIP courseware can best be developed.

GUIDELINES FOR DESIGNING COURSEWARE FOR THE COMPUTERIZED HAND-HELD INSTRUCTIONAL PROTOTYPE (CHIP)

CONTENTS

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LIST OF EXHIBITS

GUIDELINES FOR DESIGNING COURSEWARE FOR THE COMPUTERIZED HAND-HELD INSTRUCTIONAL PROTOTYPE (CHIP)

CHAPTER 1: INTRODUCTION

General Purpose of This Guidebook

This document presents guidelines for designing courseware for the Computerized Hand-held Instructional Prototype (CHIP). CHIP is a small, battery-powered training aid useful for a variety of military and nonmilitary applications. Courseware is computerized lesson material. It can be distinguished from more general software (computer programs which do not directly present lesson material) and hardware (the computer itself). Even the human element--instructors, educational specialists, training evaluators, training supervisors, and so on--has a high-technology name these days: "warmware." This guidebook focuses on CHIP courseware as it relates to a total training system, which also includes software, hardware, people, and a variety of other training elements. This document contains reviews of the research rationale for CHIP's instructional routines and some background on the development of CHIP. For future use in decision-making and authoring, the more procedural portions of this document will be extracted and disseminated as a how-to manual for performing a CHIP application.

CHIP is a portable, battery-operated, computerized training aid about the size of a standard looseleaf notebook and weighing about six pounds. Courseware for specific kinds of training (for example, training related to a particular job) is contained in interchangeable, plug-in cartridges and in an accompanying booklet that is mounted just above the unit's visual display screen. Synthesized voice, special audiovisual effects such as missile tones, and four different instructional routines are used to provide intrinsic motivation and to enhance the effectiveness of training. CHIP has a recordkeeping capability that makes it highly useful for tracking the progress of individuals or groups. A more complete description of CHIP and its capabilities is addressed later.

Audiences for This Guidebook

Three main audiences are envisioned for this guidebook:

- Military and civilian personnel who are generally interested in keeping abreast of innovative training technologies
- Individuals and agencies desiring to explore the possiblity of using CHIP in the military (and perhaps in other settings, such as business, industry, government, and public schools--all of whom have expressed an interest in CHIP)
- Individuals such as subject matter experts, educational specialists, or instructional technologists who might be tasked with selecting training content and/or developing courseware for CHIP.

Since Chapters 1 through 3 present a great deal of background information, the first and second audiences will find those sections of particular interest. The focus of the document, however is in Chapters 4 and 5, where discussions include how to match training needs to instructional medium and how subsequently to develop courseware for CHIP. These chapters provide insight and guidance to the second and third audiences.

Questions Answered by This Guidebook

Specific questions answered by this guidebook include:

- What is CHIP? (This question is asked by all three audiences noted above.)
- What can CHIP do? (Again, this is for all three audiences.)
- What training needs can CHIP fulfill in my own situation and environment? (This is especially for the second and third audiences.)
- How can I plan for and develop appropriate courseware for CHIP in order to fulfill training needs in my own situation? (Likewise, this is a question asked by the second and third audiences.)

How This Guidebook Is Organized

Chapter 1 of this guidebook introduces CHIP in terms of its joint-service character, its place in a total training system, and its advantages. This chapter also targets the audiences for the guidebook and lists key questions to be addressed.

Chapter 2 describes what CHIP is and what it can do. A brief discussion summarizes CHIP's physical capabilities and characteristics, types of training to which CHIP is best suited, instructional routines related to those training types, and learning strategies implicitly encouraged by CHIP. The research rationale for CHIP's various features is also addressed.

Chapter 3 provides examples of the first five CHIP applications and describes the ways these applications demonstrate CHIP's capabilities. The evaluation of CHIP via these five applications is also mentioned.

It is essential to match training needs with the most relevant instructional medium. Chapter 4 presents a method for determining whether CHIP fulfills given training requirements in a particular environment (using a media selection procedure).

Assuming CHIP has been selected as the instructional medium, Chapter 5 offers information on how to develop courseware for CHIP using the curriculum conversion concept (converting existing, traditional, print-based materials to CHIP format when appropriate). Issues such as communication, time, and cost are also included in this chapter.

CHIP and Its Joint-Service Sponsorship

CHIP is the product of a joint-service military effort to increase the flexibility of training programs, ease the burden of training instructors and job supervisors, and assist military personnel who are learning their technical jobs or refreshing their job skills. Army, Navy and Air Force personnel, as well as civilian technologists, have had strong roles in shaping the nature and purposes of CHIP through a joint-service CHIP Working Group.

The members of the Working Group decided issues of technical adequacy and practical applications of CHIP and worked with the government's chosen CHIP contractor, Technology Incorporated (TI) of Dayton, Ohio, as TI developed the hardware, software, and courseware for the first five CHIP applications. Finally, the Working Group provided guidance to the test and evaluation phase of the CHIP project. The result of all these efforts is the development and testing of a set of five initial CHIP applications, which were designed to demonstrate the feasibility of CHIP as a training aid for potential joint-service acquisition.

The joint-service character of CHIP is illustrated by the range of the first five applications, as shown in Exhibit 1. The Army has two of the initial applications. One Army application is designed to train crewmen on the Chaparral air defense system at the Army Air Defense Artillery School, which is also the proponent for CHIP. The other application focuses on vehicle recovery operations at the Army Ordnance Center and School. Both of these applications are sponsored by the Army Training Support Center (ATSC). The Army Research Institute for the Behavioral and Social Sciences is providing technical support, particularly to the two Army applications. The Navy's application is centered at the Quartermaster "A" School and concerns celestial navigation calculations. The Center for Naval Technical Training (CNTT) is the sponsor, with technical assistance from the Naval Training Systems Center. The Combat Arms School at Lackland AFB Center is the locus of the Air Force application, which involves M-60 machine gun operations under the sponsorship of the Air Training Command at Randolph AFB. Personnel from Brooks Air Force Base are also involved in CHIP planning. Finally, an interservice application is found at the Explosive Ordnance Disposal (EOD) School. This application covers reconnaissance and disposal procedures for explosives. The sponsor is the Naval EOD School, with participation from Navy, Army, and Air Force personnel and with technical support from the Naval Training Systems Center. The Navy Personnel Research and Development Center has served as consultant for the instructional and gaming features of CHIP.

CHIP

SERVICE	USER SCHOOL	SPONSOR	APPLICATION
ARMY	AIR DEFENSE ARTILLERY	ATSC	CHAPARRAL CREWMAN
ARMY	ORDNANCE	ATSC	VEHICLE RECOVERY OPERATIONS
NAVY	QUARTER-MASTER (A)	CNTT	NAVIGATIONAL CALCULATIONS
AIR FORCE	COMBAT ARMS SCHOOL	ATC	M-60 MACHINE GUN OPERATIONS
INTER-SERVICE	EXPLOSIVE ORDNANCE DISPOSAL	EOD	RECONNAISSANCE AND DISPOSAL PROCEDURES

Exhibit 1.

Five CHIP Applications

Specific Products of the CHIP Effort

Specific products of the CHIP effort are shown in Exhibit 2. These include functional specifications for CHIP; prototype units for demonstration and evaluation; five instructional databases (one for each of the first five applications); guidelines for converting a traditional, book-based curriculum to computerized CHIP format (this document); an authoring aid with an accompanying user's guide; an instructor's guide for using CHIP in the training site; a cost analysis; and a technical data package.

The current guidebook is a practical compilation of general information concerning CHIP and procedural information for selecting and developing courseware. This guidebook is one of three CHIP documents that will be most useful to training practitioners. The other two are the authoring aid user's guide and the instructor's guide.

How CHIP Fits Into a Total Training System

CHIP is intended to supplement and reinforce the role of military training instructors. As a small, portable training unit, CHIP should be viewed as part of a total training system, which also includes:

- Curriculum developers, instructional systems development experts, subject matter experts, instructors, training evaluators, training supervisors, and, of course, the students themselves
- Technical training books, such as field manuals, technical manuals, and so on
- In the case of basic skills training, textbooks, workbooks, and other book-based materials
- Other print material, such as student guides, programs of instruction, and instructor's manuals
- Standardized tests (either written or performance-based)
- Instructor-made tests and quizzes
- Large-scale computerized training devices, such as simulators and videodisc units
- Individual desktop microcomputers, which either stand alone or are linked with a mainframe computer
- "Local area networks" of microcomputers
- Audiotape units
- Other audiovisual devices
- Actual weapons systems or other devices used for hands-on training
- Various combinations of the above human and machine capabilities used for instruction and evaluation

TRAINING AID

- FUNCTIONAL SPECIFICATIONS
- PROTOTYPES FOR DEMO AND EVALUATION
- APPLICATION DATABASES

IMPLEMENTATION

- GUIDELINES FOR CONVERSION TO CHIP
- AUTHORING CAPABILITY
- INSTRUCTOR'S GUIDE FOR IMPLEMENTATION

ACQUISITION

- COST ANALYSIS
- TECHNICAL DATA PACKAGE

Exhibit 2.

CHIP Products

Advantages of CHIP

CHIP can be seen as an example of "downsized computer-based training technology." It is intended to complement other trainers--human, printed, mechanized, or computerized. Key advantages of CHIP are as follows:

- CHIP is low-cost, light-weight, and portable.
- CHIP is useful in a variety of settings and is not chained to the classroom environment.
- CHIP provides an accessible means of transforming lull time into training time, whether in school, on the job, or at home.
- CHIP is "ruggedized" to withstand wear-and-tear in most field training settings.
- CHIP supports initial training, refreshes or sustains prior training, and offers "distance training" when the student is separated from the instructor.
- CHIP provides interactive instruction that paper or book cannot offer.
- CHIP gives more interaction and more on-task time than is possible in any instructor-centered classroom situation (other than perhaps a one-to-one student-instructor tutorial environment).
- CHIP provides greater "individualization" of instruction than can the typical classroom instructor, thus dealing more effectively with ever-present individual differences in aptitude and learning rate among students.
- CHIP provides more detailed, more personal recordkeeping than is possible for an instructor working with paper or observations in a large group of students.
- CHIP eases the training load placed on microcomputers and other computer-based systems by transferring fact training, procedural training, and terminology training to the simpler, hand-held computer.
- CHIP thus frees the more sophisticated computerized systems and devices to train creative problem-solving, decision-making in high-fidelity simulations, and coordinated task performance.
- CHIP is intrinsically motivating due to its four different instructional routines, which are based on the best features of gaming techniques as applied to instructional technology.
- CHIP has specific courseware related to particular technical areas or jobs.
- CHIP's specific courseware is interchangeable and may be substituted through cartridges that contain up to 20 hours of instruction apiece.

- CHIP has an audio capability that many computer-based training systems lack.

- CHIP's graphics capability resides in its booklet and its visual display screen.

These advantages and other attributes of CHIP are presented in more detail throughout this document.

CHAPTER 2: CHIP AS A COMPUTERIZED HAND-HELD TRAINING UNIT

Purpose of This Chapter

The purpose of this chapter is fivefold:

- To describe the current status of microcomputers and training
- To provide a rationale for computerized hand-held training aids
- To cite the hardware advances of CHIP
- To explain in some detail the kinds of instructional routines available on CHIP as they relate to various training content and different training requirements
- To mention the types of learning strategies that are implicitly taught in CHIP

To understand the development of computerized hand-held training aids, it is helpful to have some background on microcomputers and training. This chapter is intended to provide information about CHIP to school decision-makers. For a review of the research that went into the design of hand-held training aids, see the following subsection on CHIP Courseware.

Microcomputers and Training

A desktop microcomputer is a rather powerful computer that can be used to satisfy the needs of business, laboratory, home, and school. The microcomputer, because it is a general tool, is equipped with capabilities that are beyond the need of many training applications. For example, the standard microcomputer keyboard is needed if one is to enter text as a response to some instructional routines; however, in many or even most computer-based training (CBT) applications, responses usually require only a small number of keys (such as four letters for a four-item multiple choice or two letters or numbers for yes/no). In such cases, the response-limited aspect of CBT renders the standard keyboard unnecessary. For the purposes of many training applications, arguments can also be made against the cathode ray tube, the standard 24-by-80-character display area, and other hardware features usually found in a microcomputer.

The microcomputer has served well in validating the efficacy of training by means of electronic delivery. When delivered by microcomputers, CBT has been shown to have advantages over traditional instruction for certain purposes. For example, CBT can often do the following things that traditional instruction cannot easily do (Ahmad, Corbett, Rogers, & Sussex, 1985; Hartley & Lovell, 1985):

- offer highly interactive learning in a constant fashion
- immediately and rapidly assess student responses
- display messages
- take the student through subsequent attempts at a question

- "branch" the student to another part of the courseware depending on the nature of the response
- provide explanation and feedback to the student frequently and without a time lag
- accommodate different rates of learning (or, alternatively, place limits on the time available for answering questions)
- keep meticulous records on student responses
- provide a variety of instructional routines
- free the teacher from some constraints imposed by heavy teaching schedules
- take over some of the more mundane instructional tasks
- provide personalization of instruction
- offer intrinsic motivation and challenge

The availability and decreasing cost of the microcomputer are key factors in its growing presence in the training classroom. However, therein lies the problem. The still rather bulky dimensions of the microcomputer and its power requirements tie it to a classroom or an institutional setting. A smaller, more compact, more portable computerized training aid is ideal for some training applications, especially those which lie outside the traditional classroom setting.

Rationale for a Computerized Hand-held Training Aid

The condensation of increased computational capability on a decreased physical area is the cornerstone of microprocessor technology. The development of new integration techniques that compact thousands and even millions of circuit elements on a single piece of silicon has led to shrinking system sizes, expanding address spaces, increasing speeds, and falling prices. For training applications, advances are being made in miniaturizing computerized training equipment to dimensions suitable for personal use by military personnel in classroom and nonclassroom settings.

Light-weight, hand-held, battery-operated, computerized training aids can offer most of the advantages of CBT in a more convenient delivery medium. When scaled down to such a size, these aids dramatically increase the opportunities of CBT use. Hand-held training aids can accompany military personnel in a variety of living and working areas. Lull time (for example, waiting for one's turn for a Chaparral performance evaluation, riding on the bus to the field site, relaxing in the day room, or waiting at the dentist's office) can be converted into training time by means of hand-held training aids. Certain areas of the curriculum, such as drill and practice, can be "shifted" onto these computerized devices, thus reducing the teaching load in routine curriculum areas and allowing instructor time to be dedicated to other curriculum areas. The efficiency of these devices and their interactive nature can improve student performance and motivation. CHIP was designed to fulfill the potential of hand-held training technology. The next section describes specific features of CHIP.

CHIP Features

The basic philosophy behind the development of CHIP is that learning is more likely to occur when made more interesting and more convenient. In developing CHIP, an attempt was made to capitalize on the features of an earlier training aid developed by the Army Research Institute--the Tutor--to demonstrate the feasibility of hand-held training technology. The effectiveness of Tutor was successfully demonstrated in training MOS-related technical vocabulary (Harman, 1986).

Features of Tutor that contributed most to its effectiveness are portability, convenience of use, audiovisual capability, its gaming approach, and the instructional features of its training routines. The final CHIP design is depicted in Exhibit 3.

CHIP was designed to provide job-related vocabulary instruction as well as job-oriented procedural training. CHIP's design includes an eight-line display in addition to its audio capability, and five different kinds of training routines. Other features offered by CHIP include:

- up to 50 hours of operation for each of five applications
- courseware (up to 20 hours per plug-in cartridge)
- recordkeeping capability for student information
- communication capability to link CHIP with a microcomputer
- additional keyboard functions
- protection cover and carrying handle
- special shielding for the body of CHIP to endure rough treatment
- commercially available batteries
- authoring capability

The following section briefly discusses CHIP's hardware (electronics and physical configuration) and its routines.

CHIP Hardware

Electronics Design: CHIP's main printed circuit board contains a microcontroller, memory, logic, speech and driver circuits. The removable courseware cartridge contains a smaller printed circuit board, which is enclosed in plastic housing for protection. To enable the longest possible operating time without battery recharge or replacement, complementary metal oxide semiconductor (CMOS) technology is used in all electronic components except for the speech chip.

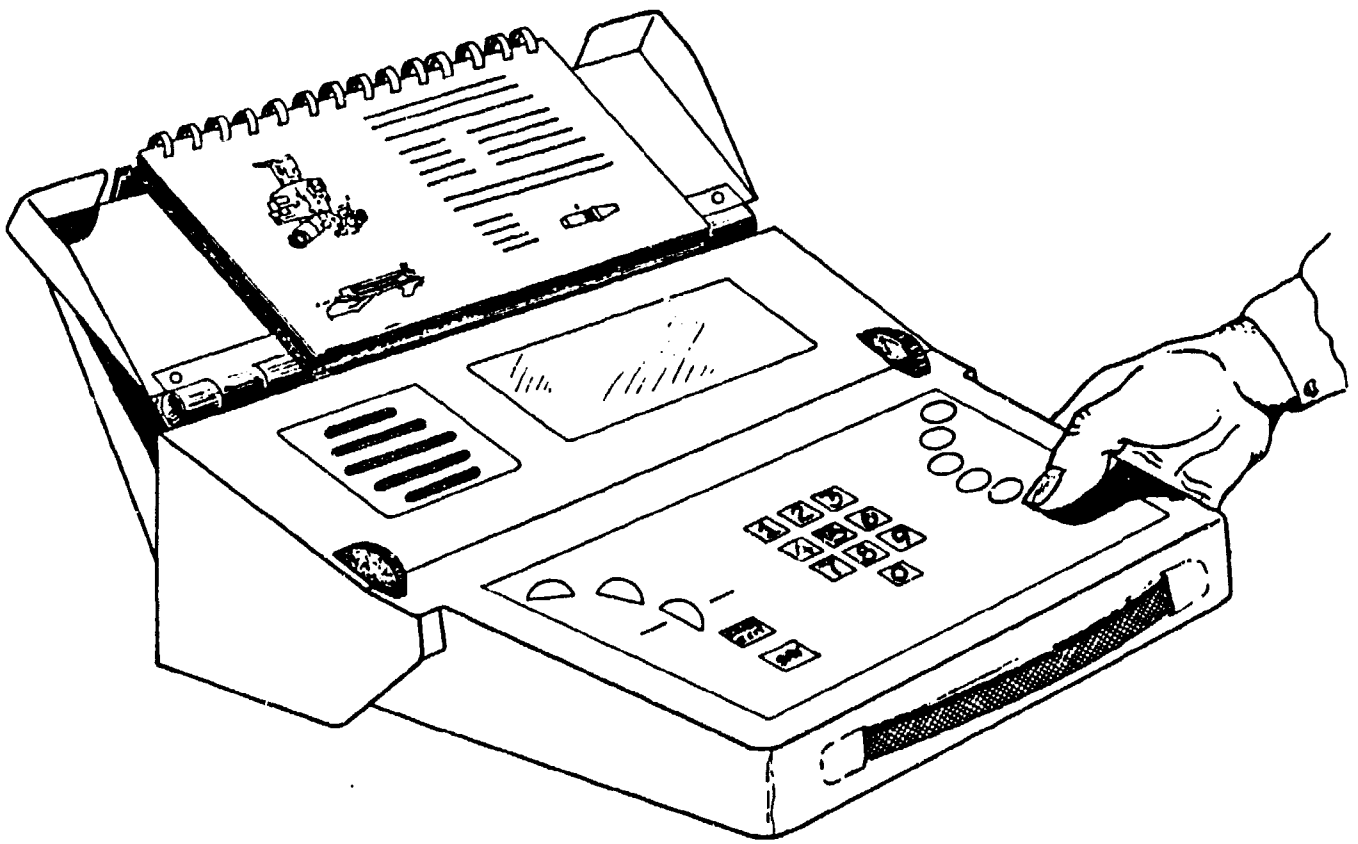


Exhibit 3.

Computerized Hand-held Instructional Prototype
(CHIP), Open Position

CHIP is powered by four or eight removable "D" size batteries. Rechargeable nickel cadmium (NiCad) batteries are standard, but alkaline batteries can be used. With four NiCad batteries, CHIP can operate for up to 30 hours without a recharge.

The microcontroller, an Intel 80C31, has externally programmable read-only memory (EPROM) rather than built-in ROM. This allows for easy exchange of programs. The 80C31 directly addresses 64K bytes of external program memory and 64K bytes of external data memory.

Speech is generated by a General Instrument SP1000 speech synthesizer. Words, phrases, and special sound effects are initially developed off-line on a cassette tape recorder. Then the analog audio is fed to a Telinnovation speech digitizer system that is part of a special CHIP authoring aid that can be installed on an IBM Personal Computer. The digitized audio is downloaded from the authoring aid into programmable ROMs for installation into the CHIP courseware cartridge.

Non-volatile RAM memory enables records to be kept on as many as twelve students at a time. An abbreviated performance graph that depicts individual learning progress can be displayed on CHIP's screen; complete records can be uploaded via an RS-11 communication port to a microcomputer for detailed analysis.

The memory on the main printed circuit board contains display, speech, and instructions common to all subject matters, plus the non-volatile student recordkeeping memory, which is of the random access memory (RAM) variety. The non-volatile RAM is an 8K byte Dallas Semiconductor DS1225, which uses an integral lithium energy source to maintain the data when the power to the CHIP is turned off.

The cartridge memory contains display, speech, and instructions unique to a particular course subject. The board has provisions for up to twelve 32K byte programmable ROMs, or 384K bytes total, to be used as needed for particular applications. For reasons of economy, at present these are ultraviolet-erasable ROMs. However, the design is upwardly compatible to allow the use of advanced memory technologies, such as high-density RAM or electrically erasable programmable ROM (EEPROM) if these technologies become more economical in the future.

Physical Configuration: Approximately 10-1/2 in. by 12 in. by 3 in., CHIP weighs about 6 pounds with four NICAD batteries and without the book. CHIP's external design was determined by human factors' principles. In addition to CHIP's lightweight size and shape, the geometry and layout of the response keys, controls, and indicators are optimized to facilitate heads-up operation. For example, sculpted grips on the sides of the device comfortably position the user's hands. The main response keys are to follow the natural reach of a soldier's thumb (calculated on available 5th/95th percentile norms from NASA anthropometric databases). (NASA, 1978; MIL-STD-1427C, 1981) Keys are functionally distinguished by color and shape. (See Exhibit 3) In addition, the visual display screen slopes up from the keyboard area to give an optimal viewing angle of 22 degrees (MIL-STD-1472C, 1981).

A hinged plastic lid, when closed, provides protection for CHIP's controls and storage for the book and for an earphone. When folded back, the lid serves as a sturdy bookrest. When stowed, the book lies over the keyboard, providing extra padding for protection of the machine. When the lid is folded back and secured, the book's rigid cover fits into a pocket that secures the book directly above the display screen in approximately the same visual plane as the display screen.

CHIP Courseware

CHIP has four generic instructional routines that may be used for any specific training application. Three of these instructional routines have game features added. Corrective feedback is provided within the game format.

Games were incorporated into CHIP so that the learning would be intrinsically motivating (as opposed to the external motivation of school grades or instructor approval). Intrinsic motivation can increase the initial likelihood of student involvement and decrease the likelihood of disengagement once activity has begun (Condry & Chambers, 1978). Gaming features, if they are effective, may enhance learning by increasing the amount of time that is spent on the training task. The amount of time spent on a given learning task is important; increased task-related time is associated with better learning performance, according to Denham and Lieberman (1980). The amount of time spent on a given task is important not only in laboratory settings but also in typical classrooms (Stallings, 1980) and in training operational procedural skills (Knerr, Harris, O'Brian, Sticha & Goldberg, 1984).

Several studies have been conducted to determine the variables that make video games motivating (Bobko, Bobko, & Davis, 1984; Malone, 1981). Variables that were correlated with game popularity were scoring, audio effects, randomness, and graphic effects in Malone's research; and destructiveness, dimensionality, and graphic quality in the research by Bobko and others. Malone also found evidence for the importance of intrinsic fantasy feedback.

The instructional routines designed for CHIP incorporate the motivational aspects of games. The games all have substantial graphic effects occurring after every response. Audio effects have also been integrated into the graphic effects. The tasks have well-defined goal structures which are displayed on the screen. Scoring systems supplement and enhance the graphic effects. Although randomness is not a strong component in the routines, the advanced CHIP games do utilize time pressure, which Malone (1981) has suggested can be useful for increasing the challenge of tasks.

The four CHIP instructional routines include one regular routine and three gaming routines:

- Warmup exercises and an Explanation mode with embedded questions
- Roll Call, in which the student matches terms to their definitions or vice versa in a game format
- Target Practice, in which the student uses a game format to identify items in a picture or answer various questions about a picture

- Mine Field, which reviews step-by-step job procedures and provides drills in a game format.

Exhibit 4 summarizes CHIP's instructional features.

Courseware for each of the various training applications is typically divided into 30 to 40 "segments," or parts of lessons. Each segment uses the Warmup/Explanation routine and at least one gaming routine--as many as are applicable to its subject matter content.

To accommodate individual differences in ability and learning and to provide further challenge to students once basic proficiency has been achieved, each instructional routine (except for Warmup and Explanation) has both a basic level and an advanced level, called Level 1 and Level 2 (Expert) by CHIP. The advanced level differs from the basic level principally by the imposition of a time limit and (for two of the routines) in the requirement that the student respond YES or NO to each answer choice, in turn, as it is presented.

During all training routines, students are given feedback about whether answers are correct or incorrect. Feedback for incorrect answers indicates the right answer. Feedback is an important instructional event and enhances the effectiveness of training. To be most effective, it should be informative (Gagne & Briggs, 1979).

Students control the order in which they work on segments and the order in which routines within segments are attempted. Students are given feedback about which routines and segments have been completed. Students can advance at their own pace and can "overlearn," if necessary, by additional study of segments. An advantage of giving students control over study components is that it is likely to increase intrinsic motivation (Kellar, 1983). Personal control over success can be used to increase expectancy for success.

Test procedures in games were designed so that several items always intervene before an item is retested. This technique has been demonstrated to improve the transfer of learning from short-term memory to long-term memory (Siegel & DiBello, 1980; Madigan, 1964; Reynolds & Glaser, 1964; Rothkopf & Coke, 1963, 1966). CHIP is intended to maximize performance by using this spacing effect.

The next discussion details each of the routines. Exhibit 5 presents an overview of the various routines available on CHIP.

Warmup and Explanation. This instruction is presented principally through the book, first with a series of warmup questions that use the principle of delayed feedback. These exercises are followed by illustrated tutorial material containing embedded questions that provide immediate feedback. The questions may be either contained in the book or presented on the CHIP screen. Inclusion of a gaming feature in the Warmup routine was ruled out because research has indicated (Malone, 1981) that gaming features, though useful in drills, could distract from the initial explanation process. Exhibit 6 shows an example of a screen that might occur in warmup.

CHARACTERISTIC	CHIP
PURPOSE OF INSTRUCTION	o Procedures Training o Vocabulary of Training
INSTRUCTIONAL ROUTINES	o Warmup/Explanation o Roll Call o Target Practice o Mine Field
HOW SELECT ROUTINE	o Type letter & depress GO
HOW ANSWER Q's	o Push YES or NO o Type letter & depress GO o Type number & depress GO o Type string & depress GO
FEEDBACK	o Instantaneous (except Warmup) o Usually corrective
REMEDIATION	o Yes in Mine Field
GAMING LEVELS	o Level 1 o Level 2 (Expert)
RECORD-KEEPING: ASPECTS OF USER PERFORMANCE	o Segments completed o Percentage score o Time

Exhibit 4.

CHIP's Instructional Features

ROUTINE	PURPOSE	PRESENTATION FORMAT	FEATURES*
Warmup/ Explanation	Pre-test & explain	Book, display screen	No time limit
Roll Call	Train vocabulary or math equations (non-procedural material)	Display screen	Two Levels: 1 & 2 (Expert). 10 questions: Level 1 response is yes. Missed questions repeated at intervals. Game graphic: 10 soldiers in formation. Game objective: Get 10 in line-up. Scores current % vs previous %. Maintains running score.
Target Practice	Train picture recognition or general problem-solving	Book, display screen	Two levels: 1 & 2. Game graphic: Duel with projectiles. Maintains running score.
Mine Field	Train job-step sequences	Display screen	Two levels: 1 & 2. Re-try when minor errors occur. Game graphic: footsteps & mines. Maintains running score.

*NOTE: All have corrective feedback. Level 1 has no time limit; Level 2 has. Level 2 response is always "YES" or "NO" to each answer choice.

Exhibit 5.

Synopsis of CHIP's Instructional Routines

****

GAME/ROUTINE: WARMUP (first time through)
CONDITION: Last Question (after having missed one)

SPEAKER	DISPLAY
	WARMUP SEGMENT 00
	5. (See BOOK for Question)
	? B
	END OF WARMUP. 4 CORRECT ANSWERS.
	SEE AGAIN ITEM 1.
	(PRESS GO TO CONTINUE)

SEQUENCE OF ACTIVITY:

BOOK contains question and answer choices.
CHIP prompts for answer.
STUDENT enters choice.
CHIP echoes choice on screen.
CHIP displays "End" message, number correct, prompts student to refer to first question (in BOOK) again.
STUDENT presses GO.

(If student had made no errors, the "See Again Item 1" message would be omitted, and when student presses GO to continue, CHIP would advance to the TRUNK Options Menu.)

Exhibit 6.

Warmup Screen Display

Roll Call. This routine has a gaming feature added to its words-and-definitions instructional mode. The performance objective is to match ten consecutive words correctly to their definitions, or vice versa. As in the Mine Field game, the student responds by pressing YES when the correct choice is displayed on the screen. If a student misses a word, the missed word is repeated two questions later in an increasing ratio review to facilitate long-term retention. The ten-question trials, with the words randomly rearranged, can be repeated at the user's choice. From the gaming standpoint, the objective is to build on the display screen a formation of ten soldiers, as at morning muster. With each correct answer, CHIP responds with "Here, Sir" and adds one more soldier to the displayed formation. With each incorrect answer, CHIP responds "Missing" and displays a blank slot in the formation. In keeping with the analogy, CHIP speaks "All Present, Sir" if the student scores 100% on a trial. Exhibit 7 shows example of screens that might occur in Roll Call.

Target Practice. This routine features a "friendly" projectile that progresses in one direction with each correct answer and an "enemy" projectile that progresses in the opposite direction with each incorrect answer. Friendly guns and enemy guns, as well as projectiles issuing from turn, are displayed. Finally, a new projectile is fired with each response, its distance depending on the number of correct and incorrect responses to date. In this game, the student responds by pressing letter and/or number keys, depending on the question, and is allowed to erase and correct his or her answer before pressing GO to enter the answer.

Mine Field. This game is associated with the new job-step component. In this game, footsteps are displayed progressing safely through a mine field for correct answers to procedural steps. Correct answers are chosen by pressing the YES key when the correct step is displayed on the screen. This routine differentiates between "unsafe" steps and steps that are simply "incorrect" for procedures where this distinction is critical. Choices, including correct steps, incorrect steps, and unsafe steps, are displayed one at a time in pseudo-random order. Selection of an incorrect but not unsafe step causes the foot to move sideways and requires the student to repeat the step correctly. Too many such errors result in failure. Selection of an unsafe step causes the foot to step on a mine, ending the game abruptly. Either type of failure results in the student being remediated to a Job Step Review subroutine before being allowed to attempt the game again. Successful completion of the procedure entitles the student to clear the mine field by setting off some or all of the mines--some, if his or her performance was less than perfect; all, if it was perfect. The game allows for the fact that, in some procedures, any of two or more steps might be equally correct at a given point. The game also enables a distinction to be made between main steps and substeps of a procedure, facilitating learning the procedure in organized "chunks" (Smith & Goodman, 1984).

Mine Field is considered optimal for instructing job tasks because most (although not all) procedures do involve step-by-step procedures, some of which are safety-related or otherwise especially critical steps. The game lends itself to a variety of audiovisual effects.

****

GAME/ROUTINE: ROLL CALL (Definitions Mode)

CONDITION: Correct Response (third consecutive correct)

SPEAKER	DISPLAY
chip here, sir	ROLL CALL DEFINITIONS SEGMENT 00 CHIP? Computerized Handheld Instructional Prototype 

SEQUENCE OF ACTIVITY:

CHIP displays and speaks term to be defined. Three choices are displayed on next line, one at a time, at 3.5-second intervals. Choices continue to cycle until student responds. (If the question is other than a word-to-be-defined, CHIP will ding instead of speaking the question.)

STUDENT presses YES when correct choice is displayed.

CHIP responds "here, sir" to correct response, increases score, and displays another soldier in formation.

(At ADVANCED level, each choice is offered only once; student must respond "no" to any incorrect choice before he can see the next ch[illegible]. Time is limited for each question and a clock will ti[illegible]hile CHIP awaits each response.)

****

Exhibit 7.

Roll Call Screen Display

****

GAME/ROUTINE: ROLL CALL

CONDITION: Incorrect Response (after three correct)

SPEAKER	DISPLAY
	ROLL CALL DEFINITIONS SEGMENT 00
	THE CORRECT ANSWER IS:
	Computerized Handheld Instructional Prototype
	(PRESS GO TO CONTINUE)
missing	

SEQUENCE OF ACTIVITY:

STUDENT pressed YES when wrong choice was displayed.

CHIP responds "missing" to incorrect response, leaves score as is, displays blank in formation, clears question and answer from screen, displays correct answer, and prompts for GO.

(ADVANCED level will be as described previously; buzzer would sound at the end of that time period if student had not responded and CHIP would speak "late" instead of "missing.")

****

Exhibit 7 (Cont'd).

Roll Call Screen Display

****

GAME/ROUTINE: ROLL CALL

CONDITION: Tenth Correct in a Row (on repeated trial)

SPEAKER	DISPLAY
All present, sir! You are a winner!	ROLL CALL DEFINITIONS SEGMENT 00 GAME OVER -- YOU ARE A WINNER! Last time: 90 % This time: 100 % 

SEQUENCE OF ACTIVITY:

CHIP responds "All present, sir!", displays tenth soldier in formation, displays "Game Over -- You are a winner" message, speaks "You are a winner," displays last time/this time scores, returns to options menu automatically.

(After the first trial, CHIP would have spoken "Excellent" for 90%, "Very Good" for 80 %, and "Good" for 70 %, spoken and displayed "Try again," displayed GO prompt, and re-run game when student pressed GO.)

****

Exhibit 7 (Cont'd).

Roll Call Screen Display

How CHIP instructional routines relate to various types of training content and different training requirements. Thusfar, this document has described generic instructional routines used in CHIP: Warmup/Explanation, Roll Call, Target Practice and Mine Field. Warmup provides warmup questions and an explanation. Roll Call is used for definitions, equations, formulas, and other nonprocedural content. Target Practice is used whenever the CHIP book is needed to illustrate the problem to be solved; to show controls, displays, or tools to be used; or to provide numbered lists from which to select items. Target Practice is also used whenever character-string responses are required. Mine Field is used for content that involves job-step procedures.

Drill and practice of concepts that have already been introduced and explained in the classroom, in hands-on explanations or by videotape, are eminently applicable to CHIP instruction. Procedural information, especially involving job steps, is also applicable. Facts (including technical vocabulary, visual or sound pattern recognition, shape or silhouette discrimination, or rule learning) can be taught by CHIP. To illustrate how the CHIP routines can be applied to a specific subject matter, Appendix B outlines the CHIP curriculum for training M-60 machine gun operation.

More complex instruction involving excessive memory capacity or branching to various parts of the courseware are at this point beyond the capability of CHIP. A problem arises in terms of the amount of theoretical content to be presented by CHIP. The device was not designed to provide long or complex tutorials, and the text-writing burden becomes very great when CHIP is extensively used in this fashion. A way to avoid this problem is to determine whether other methods--classroom lectures, reading from the technical manual, or hands-on practice--can present certain kinds of explanatory material better than the CHIP explanation mode can. This predetermination method is discussed in Chapter 4.

Furthermore, a very changeable curriculum may not be best for CHIP courseware development, especially if voice synthesis requirements are strong for that frequently changing curriculum. Some applications, such as Explosive Ordnance Disposal, have rapid doctrine changes requiring frequent updating of the courseware database. Other applications have a more stable curriculum and therefore do not require such frequent updates. Schools and other agencies that desire to use CHIP need to assess the frequency of changes in training content and then provide the human and engineering resources to make associated changes in CHIP courseware.

Kinds of Learning Strategies Encouraged by CHIP

Learning strategies are steps, actions, or behaviors accomplished by the learner to enhance his or her own learning. Learning strategies differ from instructional strategies or teaching techniques, which are steps, actions, or behaviors accomplished by the instructor (or the computer, in the case of CBT) to enhance the student's learning. The instructional routines of CHIP are the same as, or at least contain, instructional strategies (teaching techniques).

In the best training, however, instructional strategies and learning strategies often go hand in hand. CHIP has been structured in such a way that the learner is encouraged and implicitly trained to use certain learning

strategies. For example, the keyword method is actually a learning strategy used to memorize vocabulary. The visual-sound-and-meaning linkages forged by CHIP's Target Practice encourage the use of a kind of learning strategy similar to the keyword method. Acronyms such as RECOVERY (each letter standing for a certain operation used in Army vehicle recovery) are used in CHIP job-specific courseware. Acronyms are another type of learning strategy in the mnemonic or memorization family of strategies. CHIP's Roll Call subtly trains students to appreciate and use learning strategies related to grouping by category or attribute. Mine Field implicitly helps students learn to develop and practice their own learning strategies of reasoning, inferencing, organizing, and functional planning. In addition, the feedback provided by CHIP routines (see Exhibit 8) is a model of yet another group of learning strategies: self-encouragement, self-assessment, and self-monitoring. Since CHIP is a computerized, portable device designed to increase student involvement and on-task behavior, the learning strategies of perseverance and functional practice are valued. The explanation mode of CHIP provides examples in the use of the learning strategy of advanced organizers.

In other words, CHIP contains a number of instructional features which <u>implicitly</u> encourage useful strategies to be developed on the part of the learner.

WARMUP:

All feedback delayed.
Correct/incorrect spoken (if errors).
Correct answer displayed (if errors).
Remediate to EXPLANATION if fail.

EXPLANATION:

All feedback instantaneous.
Correct/incorrect spoken (always).
Correct answer displayed (if error).
Displays SEEK HELP if fail.

ROLL CALL:

All feedback instantaneous.
Here, Sir/Missing spoken (always).
Correct answer displayed (if error).
Supplementary feedback from game feature.
Missed question comes up again later.
Remediates to repeat of trial if fail.

TARGET PRACTICE:

All feedback instantaneous.
Correct/incorrect spoken (always).
Correct answer displayed (if error).
Supplemental feedback from game feature.
Missed question comes up again later.
Game ends if fail.

MINE FIELD:

Feedback varies.
Correct/incorrect audio cue, instantaneous.
Nature of error displayed, instantaneous.
Try again spoken/displayed, if minor error.
Correct answer displayed, if failing error.
Supplemental feedback from game feature.
Game ends if fail.
* Remediation to job-step review and re-try if fail.

*Does not remediate to job-step review at Level 2.

Exhibit 8.

CHIP's Feedback Methodology

Summary of This Chapter

Chapter 2 has presented a general discussion of microcomputers and training, with emphasis on a particular training unit--CHIP. Its hardware, external properties, and courseware have been highlighted, along with a description of the rationale for computerized hand-held training devices. As discussed, CHIP's instructional routines both explicitly teach lessons and implicitly encourage learning strategies that could be applied in other contexts.

CHAPTER 3: EXAMPLES OF EXISTING CHIP APPLICATIONS

Purpose of This Chapter

This chapter describes the first five applications and how they demonstrate CHIP's capabilities. The testing of CHIP is also mentioned in this chapter as an integral part of the instructional development process.

The First Five Applications

The first five applications include two Army applications, one Air Force, one Navy, and one interservice. Each of these is briefly described below in terms of its purposes for using CHIP.

Army Application

The U.S. Army Air Defense Artillery School (USAADASCH) at Ft. Bliss, Texas, is the proponent school for CHIP development and testing. That school is particularly interested in enhancing its Chaparral/FLIR weapons system instruction for soldiers in advanced Individual Training (AIT) and Permanent Change of Station (PCS). AIT is at Ft. Bliss; the PCS site is Ft. Lewis, Washington. Specifically, USAADASCH wants to determine whether CHIP can be used effectively during the long periods of lull time experienced by soldiers as they await their turn for hands-on performance evaluation on the Chaparral/FLIR. They can wait as long as 22 hours for a 20-minute period on the Chaparral/FLIR itself. During that waiting period they are expected to be studying Chaparral/FLIR operations from technical manuals and field manuals. Curriculum developers and instructors alike felt that the lull time could be put to more effective use through CHIP's engaging format. Some topics covered in this application include: control panel overview, reticle patterns, optical sight, hand controls, Forward-Looking Infrared (FLIR), Identify Friend or Foe tones, infrared (IR) missile tones, tone combinations, air defense warnings, engagement communications, and fire decisions. This application offers the unique opportunity to use the CHIP audio capability for missile tones and other types of sounds that are crucial for air defense.

Army Application

The U.S. Army Ordnance Center and School (USAOC&S) at Aberdeen Proving Ground, Maryland is the site of the second Army application of CHIP. The primary CHIP-related interest of the training staff at the USAOC&S is to determine whether CHIP can be used effectively to sustain information learned about vehicle recovery operations during AIT, which follows Basic Training. A second objective is to assess the utility of CHIP for soldiers who are selected for more intensive training in the area of vehicle recovery after completing Advanced Individual Training. The question of free time and the voluntary use of CHIP in the barracks day room is another interest of USAOC&S staff members. Vehicle recovery is the term for recovering wheeled and tracked vehicles which are in distress or difficulty, for example, mired

in mud. In addition to many obvious, practical requirements for recovering vechicles (such as proper cables and rigging), certain less obvious mathematical calculations of weight, resistance, angle and mire factors are necessary for success in vehicle recovery. These are part of the instructional courseware cartridge developed for USAOC&S.

Air Force Application

The Air Force application of CHIP is at the Combat Arms School and focuses on M-60 machine gun operations. The chief problem experienced in the area of M-60 operations training is that the trainees (and even their instructors) have only sporadic instruction in M-60 use. Therefore, trainees and instructors alike need supplemental and sustainment training in this area. Usage patterns, cognitive and practical performance, and attitudes are important to the Air Force in regard to this application. Some topics trained on CHIP include assembly, disassembly, malfunctions, fire control, and range cards. The site of this CHIP application is Lackland Air Force Base, Texas.

Navy Application

The Navy application deals with remedial training of personnel in the Quartermaster "A" School (Orlando, Florida) who have failed classroom instruction on subjects critical to navigation. Many students encounter problems stemming from developmental deficits such as poor experiential backgrounds, poor math skills, and weak inferential reasoning ability. CHIP was chosen to enhance the most difficult aspects of the Quartermaster "A" school curriculum. In addition to remedial training, initial training of absentees and maintenance or refresher training are possible uses of CHIP for the Quartermaster "A" School. Some of the key CHIP topics are computation of gyro error by azimuth; time and time zones; relation of arc and time; computation of sunrise and sunset; time, speed, and distance; and dead reckoning navigation.

Interservice Application

The only interservice application among the first five applications is at the Explosive Ordnance Disposal School at Indian Head, Maryland. This school presents a difficult set of problems for training. Comprehension and retention of the subject matter are literally life-or-death matters. This fact results in strong pressure from instructors for extremely high levels of student proficiency. High stress and high attrition are the outcome. Another issue peculiar to this application is that the content changes rapidly, depending on the types of bombs and other explosives being used. This means that job-specific CHIP courseware would need to be updated frequently (requiring an easy-to-use authoring tool for the school and/or its contractors). The school intends to use CHIP chiefly for remedial instruction and secondarily for enhanced training. CHIP is viewed as having the potential for reducing attrition and improving learning gains.

Evaluation of CHIP

CHIP underwent modified Operational Testing and Evaluation (modified OT&E) in each of these five applications in fiscal year 1987. The evaluations focused on the specific needs of each application, but some common variables were also examined across applications (such as performance on written tests of the subject matter, performance on hands-on tests if available, attitudes toward computers, attitudes toward CHIP, and usage patterns). Structured designs involved experimental and control groups. Results of the testing and evaluation were fed into a formal cost-benefits analysis. Reports of these results are published separately.

Summary of This Chapter

This chapter has presented a brief description of the first five CHIP applications. They span a wide range of needs, interests, content, and student populations. The test and evaluation phase of CHIP was designed to determine whether CHIP could cost-effectively fulfill the requirements of these five applications.

CHAPTER 4: HOW TO DETERMINE WHETHER CHIP MEETS SPECIFIC TRAINING NEEDS

Purpose of This Chapter

CHIP is designed to fulfill a variety of training needs: drill and practice, fact training, and job-step procedural training. It is also designed for use in different locations (classroom, bunk, day room, truck, field, and so on) for several main functions: supplementing initial training, refreshing or sustaining prior training, and providing training at a distance from the instructor via correspondence courses or other means. Yet CHIP cannot fulfill all training requirements. For example, it is clearly not useful for training complex decision-making or for instructing military personnel in hands-on teamwork of a physical task. Knowledge about the best ways to plan for and implement CHIP will be advantageous to potential new users. This understanding may be gained by following the guidelines presented here, reading the user's guide to the Authoring Aid, and contacting members of the CHIP Working Group.

How can one know whether CHIP is relevant to a specific set of training needs? Is there a process to follow that matches needs to specific kinds of instructional media, such as CHIP? Or does one have to rely solely on judgment without the help of a systematic examination of the issues? While much of the media selection process is somewhat intuitive, a systematic approach has been developed.

Useful models exist to help link training requirements with various kinds of instructional delivery systems. These models are called media selection models, because they assist in the appropriate selection of media or delivery systems to meet specific instructional needs. This chapter presents a media selection model that can be used to determine whether CHIP is relevant to a given set of training requirements.

Media Selection as Part of a Whole Instructional System

It is important to see media selection in the context of the whole instructional system. Curriculum development models, such as Instructional System Development (ISD), provide a structure that pinpoints different phases and aspects to be considered in developing instruction (TRADOC Circular 70-83-1).

Exhibit 9 depicts the entire curriculum development process. Note that media selection (found as part of specifying the instructional management plan and the delivery system) falls under Phase III, "Develop." Specifically, the media selection model is embedded in Phase III.2. Exhibit 9 clearly indicates that certain activities are already completed before media selection takes place. For example, Phase I ("Analyze") covers activities such as analyzing the job, selecting tasks/functions, constructing job performance measures, analyzing existing courses, and selecting the instructional setting. Phase II ("Design") includes activities such as developing objectives and tests, describing entry behavior, and determining sequence and structure. Only in Phase III--after analysis and design have taken place--are the instructional management plan and delivery system specified.

Although Exhibit 9 shows Phase III.2 (specifying the instructional management plan and delivery system) and Phase III.3 (reviewing/selecting existing materials) as separate and distinct, in actuality they must co-exist. It is not possible to specify the delivery system without looking at existing materials to determine whether the materials associated with one delivery system are more relevant than those associated with another delivery system. If an individual or agency wanted to determine whether CHIP were relevant for a given set of training needs, the individual or agency would naturally look at existing CHIP materials before or while deciding. For example, if an Air Force trainer has an instructional requirement for sustainment training in mathematics, he would examine current CHIP applications that include mathematics (Quartermaster "A" School and Army Ordnance). A valid judgment could then be made about CHIP's capability to handle mathematical problems in a way that appears relevant and appropriate.

As discussed earlier, CHIP courseware development is essentially a curriculum conversion effort. Traditional, book-based materials (and, if available, audiotapes or other materials) are converted into CHIP format when this is appropriate to do. CHIP courseware development should not involve much, if any, work from Phases I and II. Phases I and II should be accomplished before CHIP (or any other delivery system) is selected.

Steps in Media Selection

The media selection process described next is a modified version of the process used prior to selecting military training devices for acquisition.

The main point is that a variety of media (delivery systems or training aids) must be reviewed and evaluated, along with any existing materials, in terms of their contribution to satisfying the learning objectives.

Step 1 Review the skills which are required to complete the tasks and fulfill the learning objectives. The tasks should have been previously identified in a task analysis with the critical tasks noted (in Phase I, "Analyze"). The objectives should have been developed in Phase II.1.

Step 2 Review the entry behavior descriptions, the scope and sequence, and the learning activities already established in Phase II.3, Phase II.4, and Phase III.1.

Step 3 Locate as many media/materials potentially relevant to the objectives/tasks as practical.

Step 4 Establish a variety of categories to classify the media. The categories most frequently used include audio, print, still-visual, motion-visual, computerized, and real objects (realia). A more complete list includes the following: audio, chart, computer, Electronic Information Delivery System (EIDS), filmstrip, instructor, interactive television, large-scale mockups, motion picture, overhead projector, panel trainer, printed text, programmed text, text, radio, simulator, slides, slide/tape, television, televised cassette, videodisc, and so on. CHIP would be included in the list.

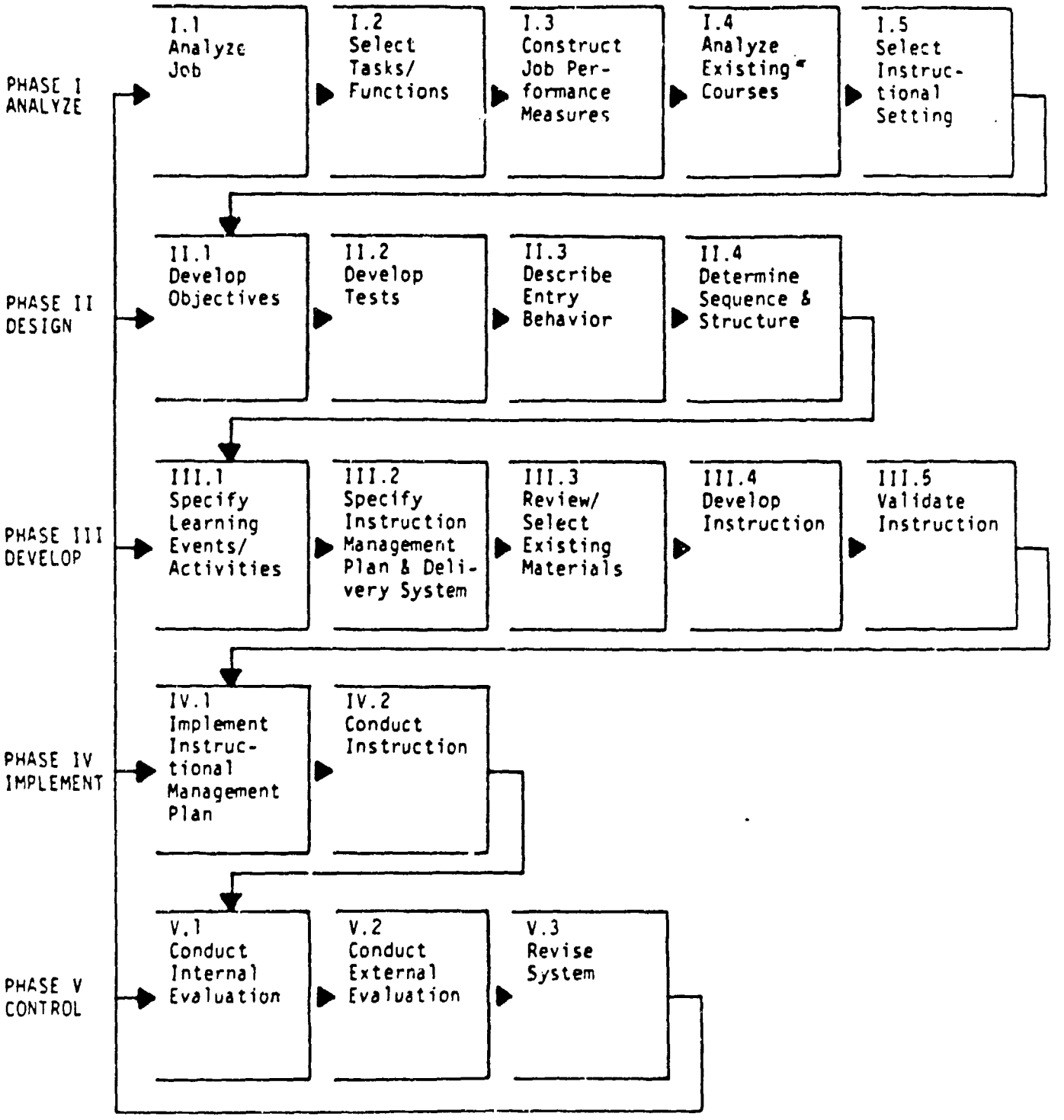


Exhibit 9.

Procedures for Curriculum Development

Step 5 Rate each possible medium on a task-by-task basis (for all tasks determined by the task analysis). Alternatively, rate each possible medium on an objective-by-objective basis. The ratings will be global and will be given in percentage points, as indicated in Exhibit 10. Examples of questions to be raised while making the global ratings of each medium include:

Does this medium inform student of task and objective? Provide student with specific instructions on conduct of task? Demonstrate correct performance of task? Allow student actively to practice task? Provide interactive guidance and prompts for the student? Provide the student with an evaluation (feedback) concerning task performance? Allow for information to be evaluated by instructor? Allow student to repeat task? Provide instruction in an interesting and motivating way? (Add other questions as needed.)

Step 6 When ratings are completed, calculate the total number of points for each medium across all tasks or objectives. Then calculate the average number of points for each medium. Finally, compare the averages and determine which medium appears to be the most relevant to the tasks or objectives.

Exhibit 11 shows a completed media selection sheet for the example of starting an engine. This is clearly a very fine-grained example involving small tasks (operator in vehicle, select proper key, and so on). The media selection process need not involve such small tasks. However, Exhibit 11 shows a useful way of completing the sheet and conducting the media selection process, no matter how broad or narrow the task or objective is.

Summary of This Chapter

This chapter has presented a media selection process in the context of the larger instructional system. This process may be useful in helping individuals or agencies determine whether CHIP meets certain of their training requirements.

The following example graph represents how a media analysis can be portrayed.

Media/Tng Aids	Classroom Lecture	One-on-one Instructor	TV Tape	Electronic Info Del Sys (EIDS)	Panel Trainer	CHIP	X,Y,Z Device
TASK #1							
TASK #2							
TASK #3							
TASK #4							
TASK #5							
TASK #6							
TASK #7							
TASK #8							
TASK #9							
TASK #10							
TASK #11							
TASK #12							
TASK #13							
TASK #14							
TASK #15*							

* Identifies a critical task.

0 - 40%	Low ability to teach and sustain.
41 - 75%	Medium ability to teach and sustain.
76 - 85%	Medium-high ability to teach and sustain.
86 - 100%	High ability to teach and sustain.

Exhibit 10.

Media Selection Sheet

Media/Training Aids	1 Classroom Lecture	2 One-on-One Instructor	3 TV Tape	4 Electronic Info Del Sys (EIDS)	5 Panel Trainer	6 CHIP	N X,Y,Z Device
*Operator in Vehicle	40	80	80	90	30	100	80
*Select proper key	30	90	80	90	40	100	90
*Locate ignition switch	20	80	90	90	10	100	100
*Insert key in ignition	10	90	90	90	80	90	100
*Turn key 45° clockwise	30	80	90	90	30	100	100
*Pump gas pedal	50	90	90	90	40	100	100
*Recognize engine start	55	80	90	90	10	80	50
*Release ignition	80	90	90	90	50	100	100
TOTAL	N/A	680	700	720	N/A	770	720
AVERAGE	N/A	85	87.5	90	N/A	96.3	90

*Identifies a critical task.

0 - 40%	Low ability to teach and sustain.
41 - 75%	Medium ability to teach and sustain.
76 - 85%	Medium-high ability to teach and sustain.
86 -100%	High ability to teach and sustain.

Alternatives 2, 3, 4,6, & N are viable medias to be considered.

Exhibit 11.

Completed Media Selection Sheet

CHAPTER 5: HOW TO DEVELOP APPLICATION-SPECIFIC COURSEWARE FOR CHIP USING THE CURRICULUM CONVERSION CONCEPT

Purpose of This Chapter

Chapter 5 provides a detailed explanation of how to develop application-specific CHIP courseware using the curriculum conversion concept. This chapter covers requirements concerning curriculum, personnel, hardware, time, and cost. Then it discusses methods of prestructuring existing curriculum materials to enter into the CHIP authoring system. The guidelines presented in this chapter are the preliminary steps necessary for converting curricula to the CHIP device. Further instruction is provided in a separately published user guide to the authoring software. Other topics, such as review and evaluation of new CHIP courseware and support issues, are also included in this chapter.

The entire process of CHIP courseware development is summarized in Exhibit 12. This exhibit shows that data from a given school are taken and shaped into an application-specific courseware outline, which forms the content of the draft segments. Work then proceeds on three fronts: audio, text (CHIP book and computerized lessons), and artwork. The book pathway is familiar to everyone: design and integrate the text (including the artwork), print the books, and bind them. The pathway for the computerized part of CHIP may be a little less familiar: integrate the audio and the computerized text via the authoring aid, burn the PROMs, and create the cartridge containing application-specific courseware. At that point, the book and the courseware are integrated in a package called CHIP.

Requirements

This section addresses requirements for curriculum development, personnel, hardware, time and cost estimates. An understanding of these issues may aid in the selection and use of CHIP.

Curriculum Requirements (Format and Content)

To make efficient use of CHIP, it is crucial that the curriculum materials be formatted in a systematic way, preferably with learning objectives supported by explanatory text and examples. Most military curricula can be described in this manner. The more structured the material is (as long as the structure is reasonable and relevant), the better the authoring tool can handle the material. However, overly complex material may not be appropriate for CHIP.

One example of well-structured military training material is TEC tapes, which are easily adapted to CHIP format. Many technical manuals are also structured in a way that make them useful for CHIP courseware development. (A later section of this chapter indicates further prestructuring which must be done in preparing existing curriculum materials for use with CHIP.)

In addition to a structured format, curriculum material that is to be converted into CHIP courseware should also contain certain kinds of content and omit other kinds. As noted earlier, CHIP is most useful for drill and practice, fact training, and job-step procedural training. The content of curriculum material which is under consideration for conversion to CHIP

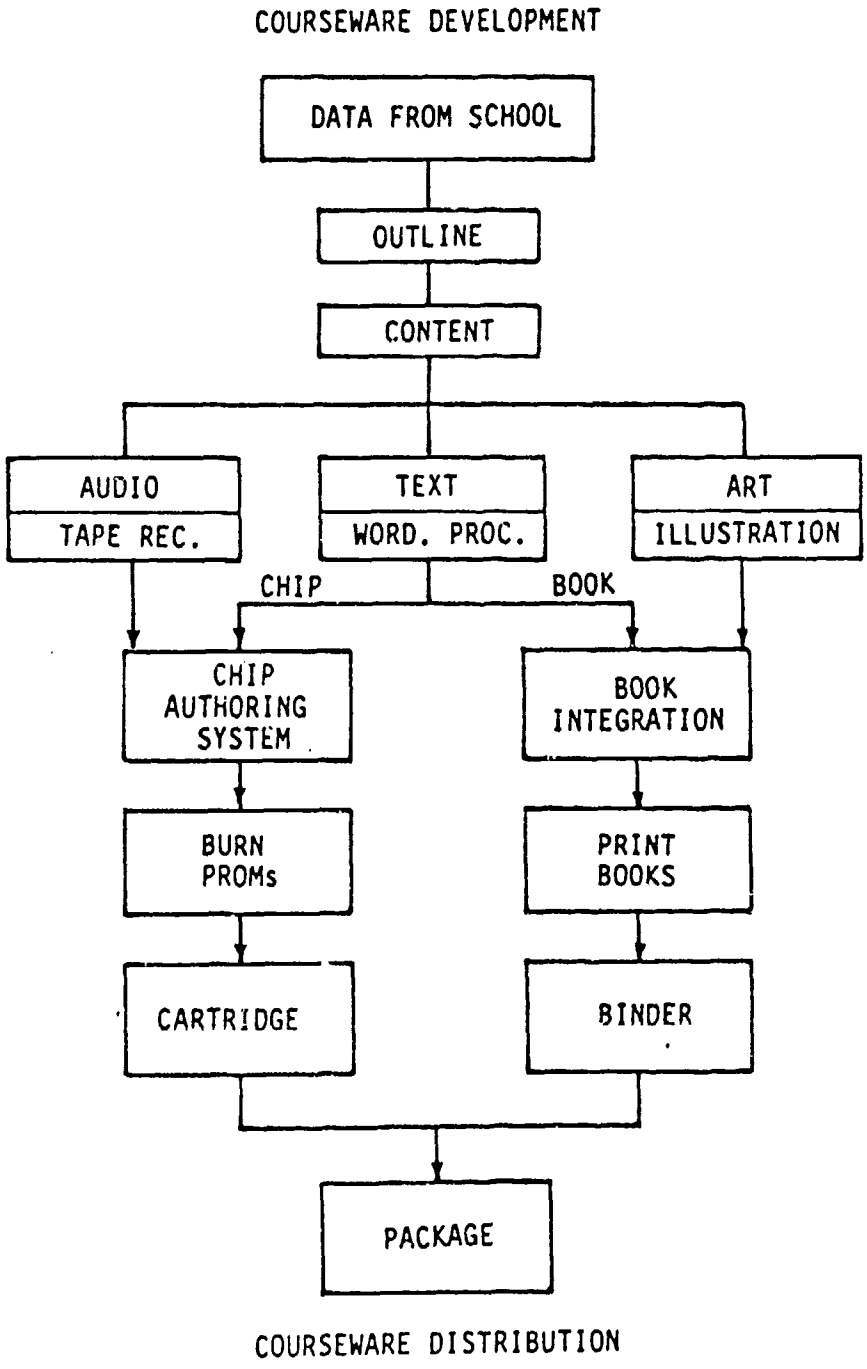


Exhibit 12.

CHIP Courseware Development Process

courseware should be one of these types. It should not include high-level, complex decision-making, psychomotor skills, or team-focused action. Curriculum content should also not be vulnerable to constant doctrine change; continual updating may require intensive reprogramming and reburning of PROMs.

Personnel Requirements

Experience with the first five applications has provided knowledge of the types of personnel needed for CHIP conversion. They include: subject matter experts (SMEs), instructors (may be the same as subject matter experts), educational specialists experienced in instructional systems development and CBT, military training managers or training supervisors, if possible a psychologist or testing expert, and a data entry/word processing operator. This operator need not have extensive CBT experience but is employed primarily to enter curriculum input into the PC.

One of the key areas of labor-intensive effort is the prestructuring of existing curriculum materials, in preparation for conversion to CHIP format. This "front-end" phase is extremely important and requires a real investment of personnel and time. Details of the prestructuring phase are provided later in this chapter.

The combination of personnel cited above worked well in the five applications described in Chapter 3. Sometimes a given site does not have all these people available. In fact, it would be unusual for all these people to be easily accessible in any one place. However, it is possible to "borrow" people who have the proper skills and background for a few hours or days to provide guidance, or for a few weeks or months to become actively involved in the courseware development. Members of the CHIP Working Group are now an experienced and knowledgeable organization. It is possible that some of these individuals would be able to provide assistance and advice. Another source is people in the central office of one's own agency who are often available if asked to help.

Just as in any development team, there must be a leader. This person has the primary responsibility for planning the steps in courseware development, setting a realistic schedule, enlisting the necessary help, and ensuring that the plans are carried out. The leader is preferably someone who knows something about CBT and curriculum development--or is willing to learn fast and takes the initiative to find resources to assist in learning.

Hardware Requirements

For use of the authoring system, an IBM Personal Computer is required. Other hardware needs include: a sound digitizer to plug into the PC or IBM PC-compatible device. The PC should have 512K memory; should run on DOS 2.1 or higher; may use IBM Displaywriter 3 WP (for example); and may utilize a laser or a dot matrix printer. A list of equipment needed for the entire courseware development process is presented below:

- IBM Personal Computer or equivalent
- Telinnovation Speech Development System installed on PC (if additional speech capability is desired), including General Instruments speech chip

- Tape Recorder (cassette or reel-to-reel) and Microphone
- Line Printer (Epson dot matrix recommended)
- Data I/O PROM-Burner
- Ultraviolet PROM Eraser
- Tray-fed Photocopier, paper cutter, and GBC-type hole-punching/bindery device

Time Requirements

A 20-hour module (CHIP book plus cartridge) takes about 400-500 person-hours to develop, if there are well-structured training materials from which to work (student guides, TEC tapes, etc.). The module contains up to 40 segments clustered into lessons as per the needs of the content area. Because of the learning curve, it will probably take less time to develop later segments than earlier segments.

In the case of the first five test applications, each school requires a single 20-hour module. However, these schools may later choose to create more modules on their own. Also, future CHIP modules, with new memory technology, should be able to store more than 20 hours of instruction. A given application might get up to 50 hours on a module in the near future.

Exhibit 13 shows interrelationships of various CHIP courseware products. Important definitions of these products are as follows:

- Components - One of four instructional routines (Warmup/Explanation, Target Practice, Roll Call and Mine Field)

- Segment - A 15-plus minute period of instruction consisting of one or only a few learning points. Currently there is a limit of 40 segments per CHIP module.

- Lesson - A collection of segments, usually between five and 20 segments (one to three hours). These segments have a unifying content or theme and refer to a given topic area. A lesson may occasionally consist of a single segment.

- Module - A 15-20 period of instruction consisting of several lessons that have a unifying content or theme. A module is physically represented as a single cartridge plus the CHIP book. Note that for the first five applications, the module is the broadest level of instruction, since each of these applications has a maximum of 20 hours. This time might expand with more ROM and more text.

- Application - For the first five applications, the term "application" is synonymous with module. However, later applications may have more than one module. An application, then, would consist of one or more cartridges and books. "Application" can also (very loosely) refer to the site where the courseware is being developed, or the people involved.

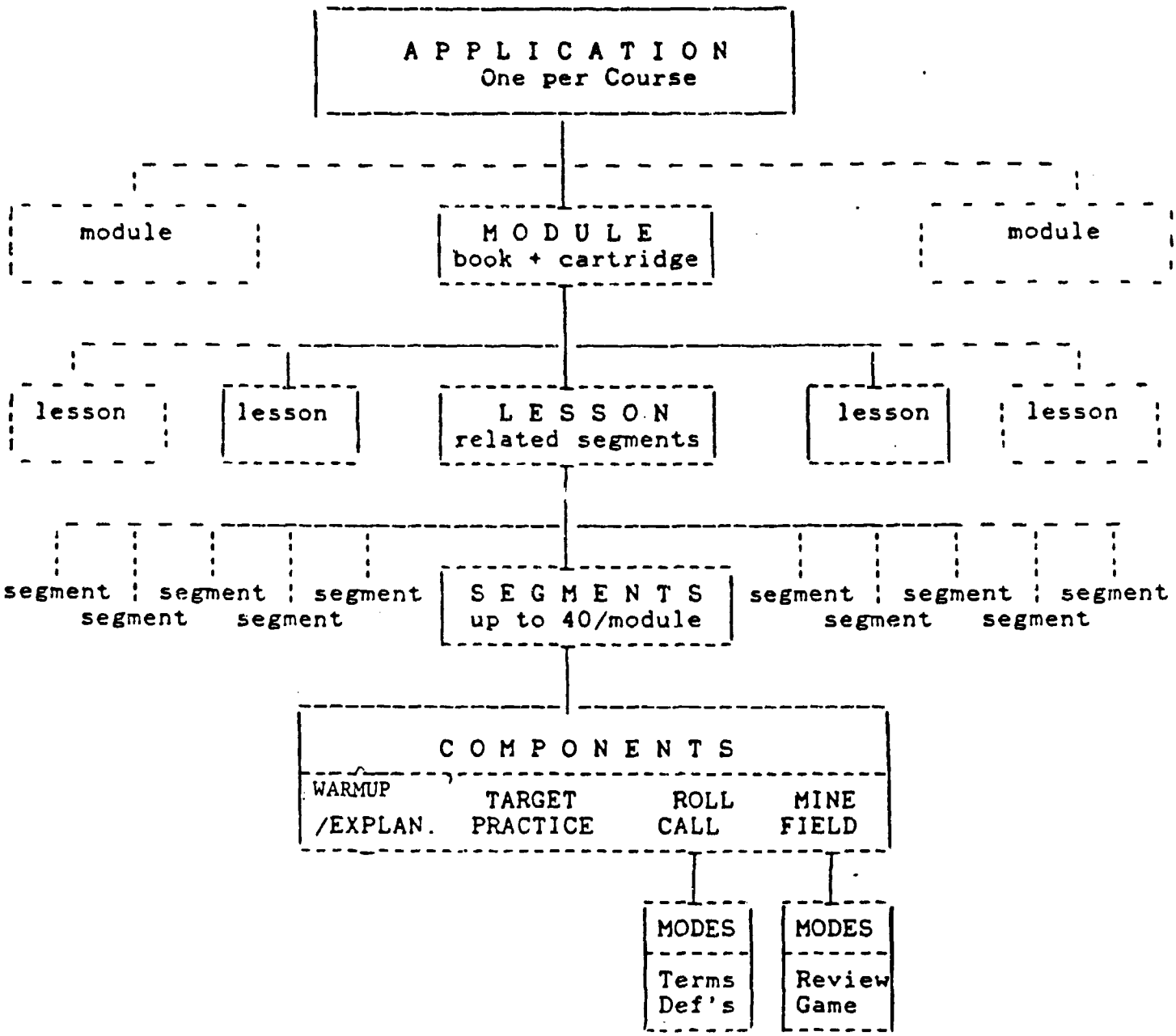


Exhibit 13.

Interrelationship among CHIP Courseware Products

- Cartridge - A solid-state memory that contains the application-specific courseware database. The cartridge plugs into CHIP.

- Book - The ring-bound book that attaches to the CHIP case and presents part of the instruction.

Cost Requirements

CHIP, when produced in large quantities (5,000 or more), is projected to cost around $200 per unit. Development costs for application-specific courseware (for new applications beyond the first five) could range from $25K to $80K, depending on how complicated the subject matter is and how well structured the source materials are.

The previous sections have addressed general requirements to be considered before CHIP courseware development is undertaken. The next section details the steps required in developing CHIP courseware.

Steps Required for CHIP Courseware Development

The process of developing CHIP courseware encompasses a multitude of steps as summarized in Exhibit 12. This document addresses three of the twelve steps. For further details on the entire process, reference should be made to the user's guide to the Authoring Aid. The overall sequence of courseware development for a new CHIP application is as follows:

1. Obtain input from SMEs including written curriculum materials
2. Develop detailed curriculum outline
3. Develop draft segments
4. Record necessary audio sounds
5. Digitize audio
6. Input CHIP text and tests via authoring aid
7. Combine digitized audio with other CHIP data
8. Finalize book text and artwork
9. Burn master PROMs
10. Verify courseware on CHIP, revise if necessary
11. Copy master PROMs into cartridge
12. Print books

Steps 1 through 3 are the focus of this guidebook and the subject of the subsequent discussions.

Input from SMEs

It is important to select existing materials which are already structured to the extent possible. In addition, a certain amount of further structuring (called "prestructuring" here because it occurs before input into the CHIP authoring system) is necessary.

The CHIP Working Group has devised two forms to aid in this prestructuring process. The first form (Exhibit 14) is known as the Background and Curriculum Description Sheet. This form provides information on:

BACKGROUND AND CURRICULUM SHEET

This sheet provides information about the curriculum being used for your CHIP application. Please be as specific as possible in your answers, because the information will be used as a partial basis for the work of the courseware writer in his CHIP software development process. The more specific the answers are, the more closely the writer can meet the needs of your application. (Attach additional sheets if you need more space.)

A. NAME OF PERSON COMPLETING THIS FORM _____

B. ORGANIZATION _____

C. POSITION _____

D. DATE _____

E. COMPLETE MAILING ADDRESS

F. PHONE Autovon _____ Commercial _____

G. APPROPRIATE SUBJECT MATTER EXPERTS WITH WHOM THE COURSEWARE WRITER COULD DISCUSS THIS CHIP APPLICATION (Provide Name, Organization, Position, Mailing Address, and Phone.)

H. PURPOSE(S) OF THIS CHIP APPLICATION — Rate in order of importance from 1 to 3 (with 1 as most important); please rate only those purposes that are clearly relevant to this particular CHIP application.

____ Initial Training

____ Sustainment (Refresher, Maintenance) Training

____ Reservist Training

____ On the Job

____ Cross-Training

____ Other (specify): _____

Exhibit 14.

Background and Curriculum Description Sheet

I. CHARACTERISTICS OF POTENTIAL TRAINEES FOR THIS CHIP APPLICATION - Please note any information about general ability level, reading level, interest level, attrition issues, probable knowledge, composite ASVAB, pay grade, etc.

J. PROBLEMS WITH CURRENT CURRICULUM - Indicate what areas trainees appear not to be understanding or retraining, and indicate why. (This may not be applicable in every case.)

K. MATERIALS WITH WHICH THIS CHIP APPLICATION WILL BE USED - Check all that are appropriate.

___With military publications (training manuals, field manuals, etc.)

___With instructor-made or SME-made student workbooks or materials

___With paper-and-pencil exercises directly linked to CHIP

___With no additional off-line aids (that is, CHIP book exclusively)

___Other (specify:_____)

L. MOST LIKELY ENVIRONMENT(S) IN WHICH THIS CHIP APPLICATION WILL BE USED - Check all that are appropriate.

___Classroom (during class time)

___Classroom (outside of class time)

___Barracks

___Field

___During down time or waiting periods

___Other (specify:_____)

Exhibit 14 (Cont'd).

Background and Curriculum Description Sheet

M. IMPORTANCE OF LESSONS - List any lessons which are more important than others (of the lessons in the material you are presenting to the contractor). If several lessons are very important, rank order them with 1 as the most important.

N. SEQUENCE OF LESSONS - Indicate any special sequence that the lessons should follow.

O. NATURE OF CONTENT OF CHIP BOOK - Indicate whether mostly pictures, words/narrative, math, special symbols, or some combination of these.

Exhibit 14 (Cont'd).

Background and Curriculum Description Sheet

- the application's purpose
- potential trainees
- problems with the current curriculum that would lead one to desire CHIP conversion
- materials with which this CHIP application will be used in a total training system
- most likely environment(s) in which this application will be used
- generalized ranking of lesson topics by importance
- any special sequence of lessons desired
- type of content desired in the CHIP book

The second prestructuring form is known as the Lesson Cover Sheet (Exhibit 15). This form helps the user break down the curriculum information to the following categories within a given lesson:

- critical tasks covered
- terminal objectives
- enabling objectives
- segments and their related objectives
- ranking segments in terms of importance
- any special sequence of segments desired
- CHIP routines relevant to particular segments
- lists of reference material, with pages and paragraphs indicated as specifically as possible, the materials attached, and annotations made in the margins of the materials when needed (appropriate and segmented material extremely important)
- special usages of words, acronyms, characters, spelling, symbols, or typographic forms that must be observed in this application
- common slogans or mnemonic devices often used in this application
- other source material
- test items other comments

Note that one Lesson Cover Sheet is completed for each CHIP lesson, or group of segments.

It may be that still further prestructuring must occur to prepare the curriculum materials for input to the authoring software. The CHIP course developer contractor may take the information from the Lesson Cover Sheets and make more breakdowns and annotations for the purpose of creating small, manageable segments that could fit into lessons. Other input from the subject matter expert that may aid in prestructuring cludes reference materials such as:

- Instructor Guides
- Student Guides and Workbooks
- Applicable books and manuals
- Test items and exercises
- Illustrations
- Glossaries and word lists
- Audiovisuals (films, TEC tapes, audio recordings)

If any of these are applicable to the segment under development, they should be made available to the course developer as soon as the project is undertaken.

LESSON COVER SHEET

This lesson cover sheet will accompany materials for each lesson in your CHIP application. Note that a lesson is a 1-3 hour period of instruction composed of a number of 10-15 minute segments (4-20 segments), which are unified by a common theme or content.

A. LESSON NUMBER_____ (REQUIRED) (Use roman numeral to distinguish from segment number.)

B. LESSON TOPIC_____ (REQUIRED)

C. CRITICAL TASKS (AND/OR SUBTASKS) COVERED BY THIS LESSON - List as many as are appropriate. (REQUIRED)

D. TERMINAL OBJECTIVES - List 1-5 terminal objectives for this lesson (REQUIRED)

E. ENABLING OBJECTIVES - List as many enabling objectives for this lesson as are appropriate. (OPTIONAL)

Exhibit 15.

Lesson Cover Sheet

F. IDENTIFICATION OF SEGMENTS AND OBJECTIVES IN THIS LESSON - List specific segments into which this lesson should be divided. Note the objectives of each segment. (OPTIONAL)

	SEGMENT TITLE	OBJECTIVES
a.	_____	a. _____
b.	_____	b. _____
c.	_____	c. _____
d.	_____	d. _____
e.	_____	e. _____
f.	_____	f. _____

(Use an additional sheet for other segments.)

G. IMPORTANCE OF SEGMENTS IN THIS LESSON - If you answered Item F, and if any segments are more important than other segments in this lesson, indicate here which segments are more important. If several segments are very important, rank order them with 1 as the most important. (REQUIRED IF APPLICABLE)

	SEGMENT	RANK
a.	_____	a. _____
b.	_____	b. _____
c.	_____	c. _____
d.	_____	d. _____
e.	_____	e. _____
f.	_____	f. _____

(Use an additional sheet for other segments.)

Exhibit 15 (Cont'd).

Lesson Cover Sheet

H. SEQUENCE OF SEGMENTS IN THIS LESSON - If you answered Item F, indicate any special sequence that the segments should follow. (REQUIRED IF APPLICABLE)

Exhibit 15 (Cont'd).

Lesson Cover Sheet

Page 4 - Lesson Cover Sheet

I. SUGGESTED INSTRUCTIONAL TECHNIQUES - Indicate which techniques relate to which segments in this lesson. For example, if Target Practice is most relevant to a particular segment, so indicate. If Pretest is relevant to all segments, indicate by listing "all" in the column marked "Segment." (OPTIONAL)

Technique	Segment (list as many as appropriate, or write "all")
Pretest (3-4 multiple-choice or true-false questions; delayed feedback provided)	
Explanation (text with question-and-answer; immediate feedback provided)	
Target Practice (general-purpose game involving answering multiple-choice questions with or without reference to a picture; this is an enhancement of Picture Battle)	
Roll Call (definition game; this is an enhancement of Word War)	
Minefield (job-step game, i.e., procedures)	
Other (including special sound effects; specify:_____)	

Exhibit 15 (Cont'd).

Lesson Cover Sheet

J. REFERENCE MATERIAL AND RELEVANT BACK-UP MATERIAL - Use the following guidelines. Pertinent material might include field manuals, technical manuals, instructor guide, student guide, existing test items, recommended test items, maps, illustrations, critical vocabulary lists, glossaries, etc.

1. List materials as specifically as possible in the space below, giving page numbers, sections numbers, etc. (by segment if possible). (REQUIRED)

2. Attach the materials to this lesson cover sheet. The materials may be cut-and-pasted. If you submit an entire publication, or a large part of a publication, annotate it to show which sections to use or choose from in constructing (a) the lesson, (b) segments of the lesson, and (c) test items. (REQUIRED)

3. Special annotations could include: (a) what kinds of questions students miss and why, (b) points where subject matter experts could help, (c) points where back-up materials could provide more clarification, and (d) useful distractors for multiple-choice questions. (OPTIONAL)

Exhibit 15 (Cont'd).

Lesson Cover Sheet

K. SPECIAL USAGES OF WORDS, ACRONYMS, CHARACTERS, SPELLING, SYMBOLS OR TYPOGRAPHIC FORMS THAT MUST BE OBSERVED - Indicate here any special forms to be observed. (REQUIRED)

L. COMMON SLOGANS OR MNEMONIC (MEMORY) DEVICES - If there exist any commonly used slogans, mnemonic (memory) devices, diagrams, etc. that are used -- officially or unofficially -- to help students remember, list below. Examples: "East is least, and West is best" (concerning latitude); RECOVERY (as an acronym to summarize the basic steps in vehicle recovery.) (OPTIONAL)

M. OTHER SOURCE MATERIALS THAT WOULD BE USEFUL - List below. (OPTIONAL) (TEC tapes, SQT reviews, flash cards, etc.)

N. ADDITIONAL TEST ITEMS - Attach separate sheet(s) of sample test items that might be helpful. (OPTIONAL)

O. OTHER COMMENTS - List below. (OPTIONAL)

Exhibit 15 (Cont'd).

Lesson Cover Sheet

All participants in the CHIP Working Group, as well as the original CHIP contractor, appreciated the value of the Background and Curriculum Description Sheet and the Lesson Cover Sheet. These individuals found that the forms were fairly easy to complete and provided a useful means of analyzing current training issues and targeting CHIP courseware so that it could address those issues directly. This prestructuring helped to formulate the user's own goals in developing CHIP courseware.

Curriculum Outline

After the completion of the Background and Curriculum Development Sheet and the Lesson Cover Sheet (and any other prestructuring forms that are more detailed than these two forms), the next step is to create the Curriculum Outline. An example of a Curriculum Outline appears in Appendix A. It is a complete list of all topics (one per segment) and indicates how each one of those topics could be covered by one or more CHIP instructional routines. The outline also provides details on source material related to each segment. Exhibit 16 presents an overview for developing the Curriculum Outline.

To create the Curriculum Outline, it is helpful first to transfer information from each Lesson Cover Sheet to long, blank pages on which all segments of a lesson can be listed. After this is done, it is possible to decide whether the originally planned lessons and their segments are appropriate or should be changed. For example, a segment might be too long or cover too many topics, and it should be divided into two or more segments. Or a segment might be too short, and it should be linked with another segment to form a new, longer segment.

After this reorganizing is completed, the next step in creating the Curriculum Outline is to decide what information to include in the Explanation mode (part of the Warm-up routine). The Explanation mode is the most time-consuming part of the segement to develop and should be carefully done. This mode requires considerable text development; coordination with a subject matter expert will help to ensure accuracy and completeness of the content. Decisions are also made about which other routines (Roll Call, Target Practice, and Mine Field) to include, based on the kinds of content involved in each segment. To reiterate briefly, Mine Field is used for job-step procedures; Target Practice is used for naming pictured items or answering questions about pictured items; and Roll Call is used for matching terms with their definitions that do not require reference to a picture. If a segment appears to need two Target Practice (picture-related) routines, then that segment should be split into two segments. A summary segment is usually included at the end of each lesson in the Curriculum Outline.

The Curriculum Outline is then typed. As indicated in Appendix A, this outline contains a cover page listing all segments and a one-page description of the routines and their content (questions and answer items) proposed for each segment. The outline is delivered to technical school personnel (subject matter experts, training supervisors, instructors, educational specialists, and so on) for their review. Based on the response and revisions from the school, the CHIP courseware developer then writes segments using a word processor for book text and the CHIP authoring aid for CHIP data.

- Break Lessons Down into Segments

  - List topics to be covered in each lesson
  - Determine number of segments (maximum is 40)

- Identify Routines to be Used in Each Segment

  - Use Mine Field for topics in step-by-step procedures
  - Use Roll Call for topics involving terminology, equations or sound recognition
  - Use Target Practice for object recognition, problem solving, or general purpose questions

- Identify Content for Each Routine of Each Segment

  - Explanation Routine:

    - List keywords of new ideas, or ideas to be reviewed
    - Identify ideas to be tested and how (maximum is 10)
    - Indicate any words to be pronounced
    - Determine illustrations to be generated

  - Warmup:

    - Identify four or five most important ideas
    - Decide type of questions (maximum is 5)

  - Mine Field:

    - Identify procedure to be drilled
    - List steps of procedure (6-19 steps)

  - Roll Call:

    - List terms to be defined (and their definitions)
    - Required number of terms per segment is 10 (if there are not enough new terms in a segment to fit the 10 required by this routine, some terms may be drawn from a previous segment)

  - Target Practice:

    - List items to be recognized (required number of questions is 10)

Exhibit 16.

Curriculum Outline Development Overview

Before using the authoring aid, it is helpful to duplicate important pages of annotated reference material related to each segment. These pages are then organized in piles in the order of the segments to facilitate immediate reference during future courseware writing.

Draft Segments

Using the Curriculum Outline for reference, draft segments are next generated. The main output of this step will be text composition, question formulation, and artwork sketches for the CHIP book. The exact text and questions to be entered into the cartridge via the authoring aid are also identified at this point.

The text (including material for the CHIP book and the CHIP visual display screen--undifferentiated from each other at this point) is then written at a word processor, with constant reference to the Curriculum Outline and the annotated reference material. Each page of the draft should correspond to a page of the 8" by 4" CHIP book. This will aid in envisioning what the student will see at any particular time.

Next a printout is made of the text as written so far, and another person reads and edits the printout for readability and accuracy. At this point the printout does not necessarily contain distractor items (incorrect responses to be presented by CHIP). If distractors are not included in the printout, the reader of the printout adds distractors. Note that all this occurs before the authoring tool is used. An example of a CHIP lesson is shown in Appendix B. For an extensive discussion on preparing the draft segments, reference should be made to the Authoring Aid User Guide.

CHIP Authoring Aid

An authoring aid is a menu-driven, already-programmed guide for formatting courseware. It differs from authoring languages, which are not menu-driven but are designed for courseware development; and from programming languages, which are general-purpose computer languages that are not designed for courseware development although sometimes used for that purpose. The authoring aid for CHIP is highly structured and provides prompts for the user. The content to which the prompts refer has been mapped out on Lesson Cover Sheets and Curriculum Outlines.

The CHIP authoring aid is designed for typical users, who are not computer programmers but who have some degree of familiarity with a desktop microcomputer. This authoring tool makes the development of many more CHIP applications possible without the help of a programmer. It also allows the updating of existing CHIP courseware databases. This is especially important for those applications in which the basic curriculum content changes periodically.

Even with excellent prestructuring as described earlier in this chapter, the CHIP courseware developer will find it necessary to "resegment" some of the lessons while using the authoring aid. This is because the structural needs of the lessons become clearer the longer one works with the material.

Review and Evaluation of Courseware Produced by the Authoring Aid

It is important to examine the courseware produced via the authoring aid to determine whether it is what was expected and desired. The evaluation process can be informal (i.e., a review of the prestructuring sheets to make sure that the initial purposes have been met, or a discussion with the instructors to get their opinions). On the other hand, full-scale test and evaluation efforts are also possible for any given application.

Necessary Communications Between Instructor and Courseware Developer

It is essential to have frequent communication between the courseware developer and at least one instructor or subject matter expert. This is important for two reasons: (a) to ensure accuracy and completeness of the courseware; and (b) to provide a means by which the instructor or subject matter expert can feel ownership over the courseware or at least involvement in the development process. The more involvement there is on the part of users, the more likely it will be that the courseware will be used correctly and constructively.

Summary of This Chapter

This chapter has covered the details involved in CHIP courseware development after the decision has been made that CHIP is relevant for a given application. A number of specific steps and important issues related to courseware development are treated in this chapter. When used in conjunction with the Authoring Aid's User Guide, this chapter provides preliminary guidelines to the entire courseware development process.

REFERENCES

Ahmad, K., Corbett, G., Rogers, M., & Sussex, R. (1985). Computers, Language Learning, and Language Teaching. Cambridge: Cambridge University Press.

Berkowitz, M., & O'Neil, H. F., Jr. (1979). An Annotated Bibliography for Instructional Systems Development. ARI Technical Report 426. Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. (AD A081 183)

Berkowitz, M., & Simutis, Z. (1983). The development of a hand-held computerized tutor for military vocabulary. Journal of Computer-Based Instruction, 41-44.

Bobko, P., Bobko, D. J., & Davis, N. W. (1984). A multi-dimensional scaling of video games. Human Factors, 26, 477-482.

Condry, J., & Chambers, J. (1978). Intrinsic motivation and the process of learning. In M. R. Lepper & D. Greene (Eds.), The Hidden Costs of Reward: New Perspective on the Psychology of Motivation. Hillsdale, NJ: Erlbaum.

Denham, C., & Lieberman, A. (1980). Time to Learn. Washington, DC. National Institute of Education.

Ellis, J. A., Wulfeck, W. H., & Fredericks, P. S. (1979). The Instructional Quality Inventory: II. User's Manual. NPRDC Special Report 79-24. San Diego: Navy Personnel Research and Development Center.

Gagne, R. M., & Briggs, L. J. (1979). Principles of Instructional Design (2nd ed.). New York: Holt, Rinehart & Winston.

Gagne, R., & White, R. (1978). Memory structures and learning outcomes. Review of Educational Research, 48, 187-222.

Goble, L. N., Colle, H. A., & Holland, V. M. (May 1986). Computerized Hand-Held Instructional Prototype (CHIP). Paper presented at the National Aerospace and Electronics Systems Society Conference of the IEEE, Dayton, OH.

Griffith, D. (1980). The keyword method of vocabulary acquisition: An experimental evaluation. ARI Technical Report 439. Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. (AD A086 880)

Harman, J. (1986, October). Application of hand-held training aid. Paper presented at the Military Testing Association Annual Meeting. San Diego, CA.

Hartley, J. R., & Lovell, K. (1984). The psychological principles underlying the design of computer-based systems. In D. F. Walker & R. D. Hess (Eds.), Instructional Software: Principles and Perspectives for Design and Use. Belmont, CA: Wadsworth.

Higgins, J., & Johns, T. (1984). Computers in Language Learning. London: Addison-Wesley/Collins ELT.

Kellar, J. M. (1983). Motivational design of instruction. In C. M. Riegeluth (Ed.), Instructional Design Theories and Models: An Overview of Their Current Status. Hillsdale, NJ: Erlbaum.

Knerr, C. M., Harris, J. H., O'Brien, B. K., Sticha, P. J., & Goldberg, S. L. (1984). Armor Procedural Skills: Learning and Retention. ARI Technical Report 621. Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. (AD A153 227)

Madigan, S. A. (1969). Intraserial repetition and coding processes in free recall. Journal of Verbal Learning and Verbal Behavior, 8, 828-835.

Malone, T. W. (1981). Toward a theory of intrinsically motivating instruction. Cognitive Science, 4, 333-369.

National Aeronautic and Space Administration (1978). Anthropometric source book, volume II: Anthropometric data. (NASA Reference Publication 1024).

Reynolds, J. H., & Glaser, R. (1964). Effects of repetition and spaced review upon retention of a complex learning task. Journal of Educational Psychology, 55, 297-308.

Rothkopf, E. Z. (1966). Learning from written instructive materials: An exploration of the control of inspection behavior by test-like events. American Educational Research Journal, 3, 241-250.

Rothkopf, E. Z., & Coke, E. V. (1963). Repetition interval and rehearsal method in learning equivalences from written sentences. Journal of Verbal Learning and Verbal Behavior, 2, 406-416.

Rothkopf, E. Z., & Coke, E. V. (1966). Variations in phasing, repetition intervals, and the recall of sentence material. Journal of Verbal Learning and Verbal Behavior, 5, 86-91.

Schulz, R. E., & Wagner, H. (1981). Development of job aids for instructional systems development. ARI Technical Report 527. Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. (AD A109 815)

Siegel, M., & DiBello, L. (1980). Optimization of Computerized Drills: An Instructional Approach. Paper presented at the annual meeting of the American Educational Research Association.

Smith, E. E., & Goodman, L. (1984). Understanding written instructions: The role of an explanatory schema. Cognition and Instruction, 1, 359-396.

Stallings, J. (1980). Allocated academic learning time revisited, or beyond time on task. Educational Researcher, 9, 11-16.

Technology Incorporated. (1985a). Computerized Hand-held Instructional Prototype (CHIP), Interim Report, Task 1, Functional Specification. Dayton, OH.

Technology Incorporated. (1985b). Computerized Hand-held Instructional Prototype (CHIP), Interim Report, Task 2, Hardware Design. Dayton, OH.

Technology Incorporated. (1985c). Computerized Hand-held Instructional Prototype (CHIP), Interim Report, Task 6, Instructional Software. Dayton, OH.

Technology Incorporated. (1986d). In-Progress Review Package. Presented at the U.S. Army Research Institute for the Behavioral and Social Sciences, Alexandria, VA.

U.S. Department of Defense. (1981). Human engineering design criteria for military systems, equipment, and facilities. (Military Standard 1472C). Washington, DC.

Wisher, R. A. (1985, April). The Development and Test of a Hand-held Computerized Training Aid. Paper presented at the NATO Symposium on Training Technology, Brussels, Belgium.

CA.STR

APPENDIX A

EXAMPLE OF CURRICULUM OUTLINE

CA.STR

SEGMENT	TOPIC	GAME(S)
1	Overview and Safety	RC
2	Description	TP, RC
3	Ammunition	TP, RC
4	Mounts	TP, RC
5	Mounting the Gun	TP, MF
6	Maintenance	TP, MF
7	Disassembly/Assembly - General Overview	TP, MF
8	Disassembly/Assembly - Stock and Buffer Group	TP, MF
9	Disassembly/Assembly - Operating Rod Group	TP, MF
10	Disassembly/Assembly - Trigger Housing	TP, MF
11	Disassembly/Assembly - Barrel and Receiver Groups	TP, MF
12	Detailed Disassembly/Assembly - Operating Rod	TP, MF
13	Detailed Disassembly/Assembly - Trigger Housing	TP, MF
14	Detailed Disassembly/Assembly - Barrel Group	TP, MF
15	Detailed Disassembly/Assembly - Receiver	TP, MF
16	Cycle of Operation	TP, RC, MF
17	Malfunctions	RC, MF
18	Firing Techniques - Characteristics of Fire	TP
19	Classes of Fires	TP, RC
20	Fire Control	RC
21	Range Determination of Types of Targets	MF
22	Methods of Application of Fire	TP, RC
23	Firing Position and General Procedures	MF
24	Limited Visibility Techniques of Fire	RC
25	Predetermined Fires	TP, MF
26	Field-Expedient Method of Laying the Gun	MF
27	Range Cards - Introduction	TP
28	Range Card Preparation	RC, MF
29	Marksmanship - Range Safety	RC, MF
30	Marksmanship Objectives, Fire Commands, Target Analysis	TP, RC
31	Bipod Training	MF
32	Bipod Zeroing	MF
33	Tripod Training	MF
34	Tripod Sight Alignment/Sight Picture Trigger Manipulation and Zeroing	MF
35	Long-Range Zeroing	MF

TP = (Target Practice, with Picture)
RC = (Roll Call, Words/Definitions)
MF = Minefield (Job-Step Game)

CA.STR

1. OVERVIEW AND SAFETY

Source: FM 23-67, Appendix C, 1-1; AFR 50-36 V1, 3-4e, p. 37

A. PRETEST: Covering weapons safety and M60 role.

B. EXPLANATION: Covering (with embedded questions):

(1) Overview of Lessons in This Application
(2) Role of M60 (Employment)
(3) General Data
(4) General Safety Requirements

C. ROLL CALL: Questions covering safety requirements, role, general data.

CA.STR

2. DESCRIPTION

Source: FM 23-67, Chapter 1

A. PRETEST:

B. EXPLANATION:

Parts - Overview

Pronounce on request: Traversing, Windage, Lateral

C. TARGET PRACTICE:

(1) Flash Suppressor
(2) Barrel
(3) Safety Lever
(4) Elevation Knob
(5) Bipod Folded
(6) Gas System
(7) Cover Latch
(8) Rear-Sight Slide
(9) Barrel Locking Lever
(10) Traversing and Elevating Mechanism

D. ROLL CALL:

(1) Flash Suppressor
(2) Cocking Handle
(3) Bipod
(4) Tripod
(5) Traversing and Elevating Mechanism
(6) Windage
(7) Slide Release
(8) Deflection
(9) Muzzle

3. AMMUNITION

SOURCE: FM 23-67, Appendix B, and General Data in Chapter 1

A. PRETEST: Covering:

(1) Cartridge Classification (what used for)
(2) Cartridge Identification
(3) Care and Handling
(4) NATO Symbol

B. EXPLANATION: Covering:

(1) Cartridge Classification and Purpose
(2) Cartridge Identification (illustrated)
(3) On-Crew Ammo Load (operational)
(4) Care and Handling (do nots)

Pronounce on request: Incendiary, Bandoleer, Corrugated, NATO

C. TARGET PRACTICE: Multiple-choice questions on cartridge classification/identification.

D. ROLL CALL:

(1) Bandoleer
(2) Round
(3) Incendiary
(4) Ball Cartridge
(5) Tracer Cartridge
(6) Dummy Cartridge
(7) Blank Cartridge
(8) Armor-Piercing Cartridge
(9) Projectile
(10) Corrugated

4. MOUNTS

Source: FM 23-67, Chapter 3

A. PRETEST:

B. EXPLANATION:

(1) Bipod

(a) When used
(b) Parts

(2) Tripod

(a) When used
(b) Parts

1) Traversing and Elevating Mechanism
2) Pintle Assembly

Pronounce on request: Pintle

(3) Vehicular Mounts

C. TARGET PRACTICE:

(1) Bipod Yoke
(2) Bipod Leg Plunger
(3) Sleeve
(4) Sleeve Latch
(5) Pintle Lock
(6) Pintle Bushing
(7) Pintle Mounting Pin
(8) Traversing Slide-Lock Lever
(9) Elevating Handwheel
(10) Traversing Handwheel

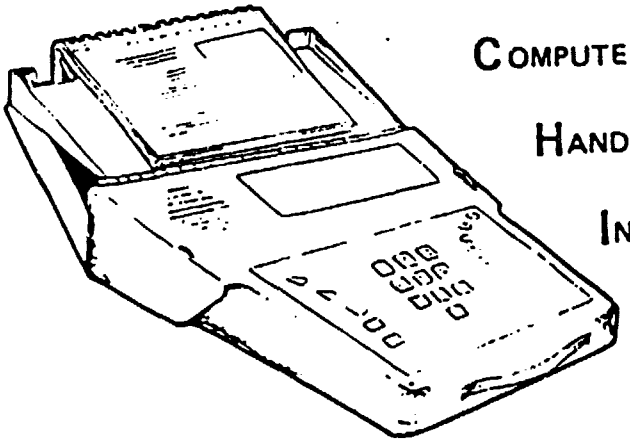
D. ROLL CALL:

Questions concerning types of mounts and functions of parts

APPENDIX B

EXAMPLE OF A LESSON

(Paper Draft Before Authoring Into CHIP)



COMBAT ARMS (M60) APPLICATION

LESSON 1

INTRODUCTION

SEGMENT

18 April 1986

SEGMENT 1: OVERVIEW AND SAFETY

SOURCE: FM 23-67, Appendix C, 1-1; AFR 50-36 Vol 1, 3-4e, p. 37; OH 6-9, para 2101

WARMUP

1. The M60 machinegun has a maximum range of:

A. 2,725 meters
* B. 3,725 meters
C. 2,725 feet
D. 3,725 feet
E. don't know

2. The M60 fires from:

A. the open cover position
B. the closed-bolt position
* C. the open-bolt position
D. any bolt position
E. don't know

3. _____ allows rapid changing of the barrels.

* A. Fixed head spacing
B. Adjustable head spacing
C. Fixed bolt spacing
D. Adjustable bolt spacing
E. Don't know

4. The gun should be transported with the:

A. cover closed and bolt forward
B. cover closed and bolt to the rear
C. cover raised and bolt to the rear
* D. cover raised and bolt forward
E. don't know

EXPLANATION

Overview:

The M60 machinegun, which weighs 23 pounds, supports the rifleman in both offense and defense. It can deliver a heavy, controlled and accurate fire at distances greater than the M16. Its maximum range is 3,725 meters.

5. The weight of the M60 machinegun is:

A. 32 pounds
B. 30 pounds
* C. 23 pounds
D. 21 pounds

The M60 is air-cooled, belt-fed, gas-operated and automatic. It fires from the open-bolt position. Ammunition is fed by a split-link belt that disintegrates [1] (breaks up into tiny pieces) as it is used.

The gas from a fired round provides the energy for the next step in the cycle of operation. Thus, the gun fires continuously and automatically as long as it is supplied with ammunition and the trigger is held to the rear.

6. Energy for continuous automatic firing is provided because the M60 is:

* A. gas-operated
B. spring-operated
C. blowback-operated
D. recoil-operated

A spare barrel with a bipod assembly is issued with each M60. Fixed head spacing allows rapid changing of the barrels.

7. Barrels can be changed quickly because the gun has:

A. adjustable bolt spacing
B. fixed bolt spacing
C. adjustable head spacing
* D. fixed head spacing

Safety:

Each gunner must comply with the following safety rules:

- Guns are assumed to be loaded until they have been thoroughly examined and found to contain no ammunition.

- Obstructions will never be placed in the muzzles of guns about to be fired.

- When not in use, all guns will be kept in a prescribed area with proper safeguards.

- Guns should be carried with the covers raised and bolts forward

- No smoking will be permitted near ammunition, explosives, or flammables.

-Hearing protection devices will be worn by all personnel during firing.

8. When a gunner is carrying an M60, it should be transported with its:

A. cylinder closed and action closed
* B. cover raised and bolt forward
C. cover closed and bolt to the rear
D. cover raised and bolt to the rear

9. Assume any gun is _____ until it has been examined and proven otherwise.

* A. loaded
B. unloaded
C. defective
D. in need of lubrication

TARGET PRACTICE

TARGET 1

CHIP will present questions and answer choices. Select only one answer unless told otherwise.

1) The M60 is _?_-cooled.
   A. gas *B. air C. water

2) The M60 is _?_-fed.
   * A. belt B. hand C. cylinder

3) The M60 is _?_-operated.
   A. recoil * B. gas C. spring

4) The M60 weighs _?_ pounds.
   * A. 23 B. 32 C. 35

5) It fires from the _?_ -bolt position.
   A. closed * B. open C. either

6) _?_ protection is worn during firing.
   A. eye B. finger * C. hearing

7) The maximum range is _?_ meters.
   A. 2725 B. 3275 * C. 3725

8) The M60 may be pointed at someone _?_
   * A. only in combat B. after clearing

9) The volume of fire is _?_ (Choose two)
   * A. heavy B. light * C. accurate

10) When not in use, the M60 bolt is __?__
   A. to rear *B. forward C. removed

SEGMENT 2: DESCRIPTION

SOURCE: FM 23-67, Chapter 1

WARMUP

1. If you can't pull the bolt to the rear, probably:
   A. the trigger spring is broken
   B. the gun is jammed
  *C. the safety lever is on
   D. the bolt needs to be oiled
   E. don't know

2. The _____ must be returned manually to its forward position each time the bolt is pulled to the rear.

   A. trigger
  *B. cocking handle
   C. safety lever
   D. bolt cover
   E. don't know

3. The windage knob is on the _____ of the rear sight.
   A. back
   B. front
   C. right
  *D. left
   E. don't know

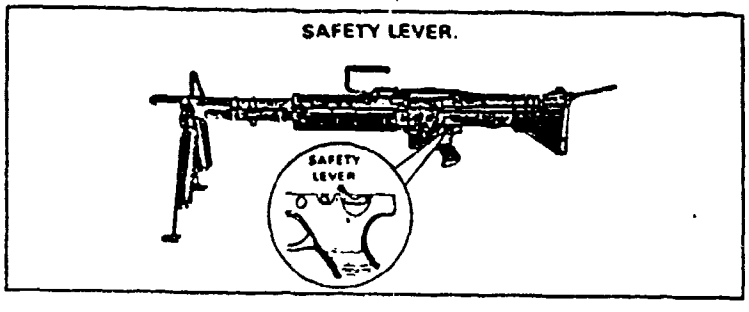
4. Major elevation adjustments are made by the:
  *A. slide release
   B. elevation knob
   C. windage knob
   D. elevating handwheel
   E. don't know

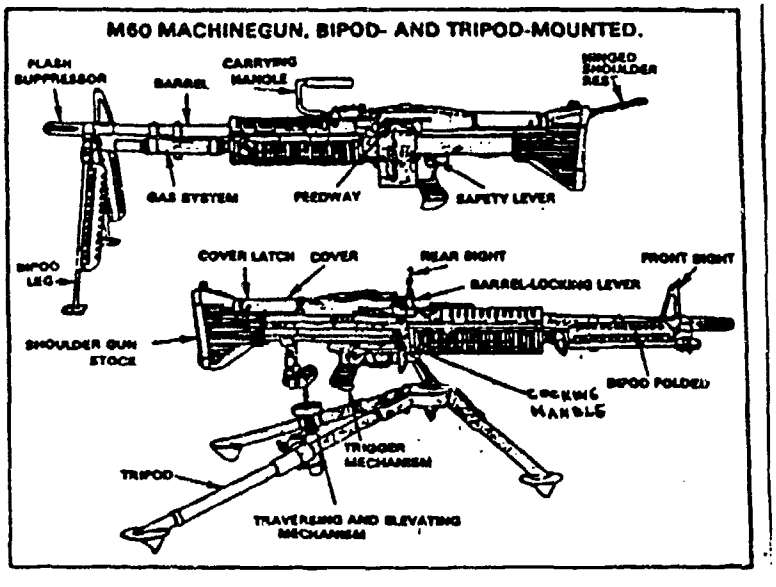
EXPLANATION

The M60 is a general purpose machinegun that can be used on a bipod [ ], a tripod [ ] or a vehicular [ ] mount. The bipod is part of the barrel assembly. The tripod provides a stable mount and permits a high degree of accuracy and control. Segment 4 covers mounts in detail.

As a gunner, you should familiarize yourself with the parts of the gun:

The safety lever is on the left side of the trigger mechanism group. It has an S (SAFE) and an F (FIRE) position. On the SAFE position, the bolt cannot be pulled to the rear or released to go forward.





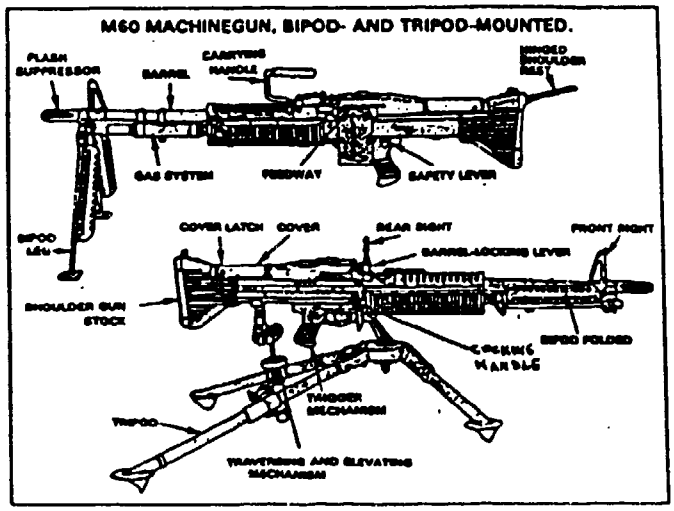
The cocking handle is on the right side of the gun. It is used to pull the bolt to the rear.

EACH TIME THE BOLT IS PULLED TO THE REAR, THE COCKING HANDLE MUST BE RETURNED MANUALLY TO ITS FORWARD POSITION TO PREVENT DAMAGE TO THE COCKING HANDLE AND INJURY TO THE GUNNER.

5. To prevent injury to the gunner, the cocking handle must be returned manually to its:

A. safe position
B. fire position
C. rear position
*D. forward position

A flash suppressor is fastened to the muzzle of the gun. During firing, the suppressor spreads out the smoke and flash from the muzzle, thus making it harder for the enemy to locate the gun and firing position.



6. The _____ helps conceal the location of the gun when it is fired:

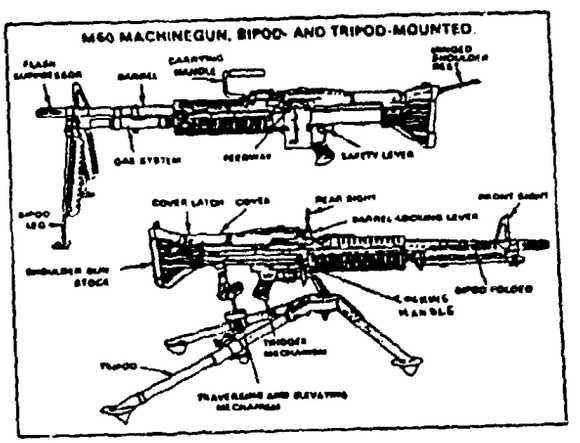
A. fire damper
B. muzzle cover
*C. flash suppressor
D. probe desensitizer

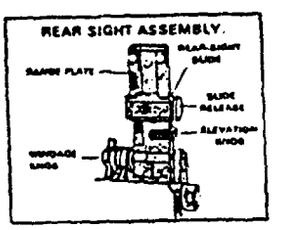
The front sight is attached to the barrel. The rear sight can be folded down when the gun is moved. The range plate scale on the rear sight is marked for each 100 meters, from 300 to 1,100 meters.

Range changes may be made by using the rear sight slide. Either the slide release or the elevation knob can be used to make range changes. The slide release is used to make major adjustments in elevation (height). The elevation knob is used to make minor adjustments.

7. The _____ is attached to the barrel and the _____can be folded down when the gun is moved.

A. front sight, front sight
B. rear sight, rear sight
* C. front sight, rear sight
D. rear sight, front sight





8. Range changes can be made by using the:

* A. slide release
B. front sight
C. windage knob
D. bipod

The rear sight is adjustable for windage [ ]. Windage adjustments are made to compensate for wide shots caused by either wind or misalignment [ ] of the sights. The windage knob is on the left side of the rear sight.

9. Sideways adjustments in aiming can be made by using the:

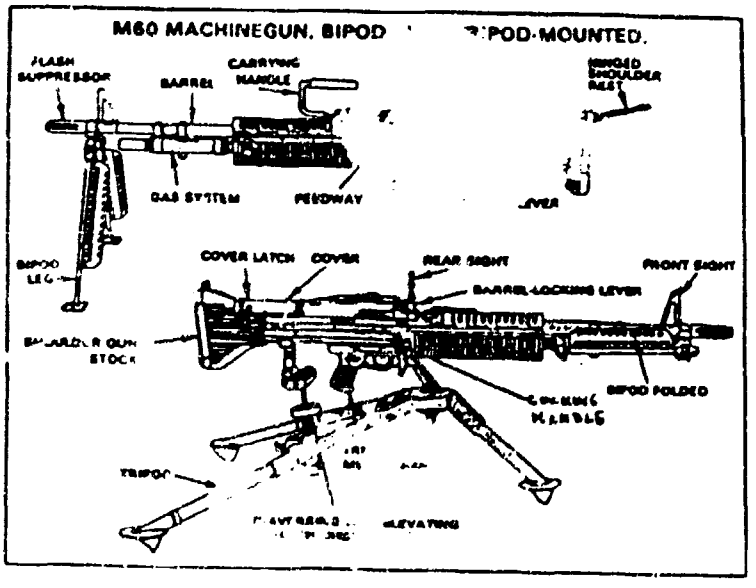
A. slide release
* B. windage knob
C. elevation knob
D. elevating mechanism

When the tripod mount is used, the traversing [ ] and elevating (T&E) mechanism is used to make lateral [ ] (side-to-side) and elevation (height and range) adjustments in aiming.

10. When the tripod mount is used, aiming adjustment are made with the:

A. windage knob
B. elevation knob
*C. T&E mechanism
D. range plate

The M60 has a hinged shoulder rest and carrying handle for convenience. Also note in the illustration the locations of the cover latch, barrel locking lever, gas system, and the feedway for the ammunition belt.

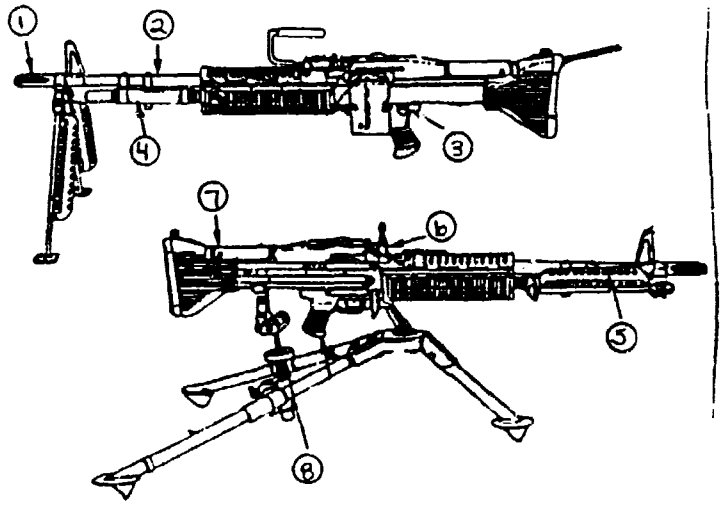


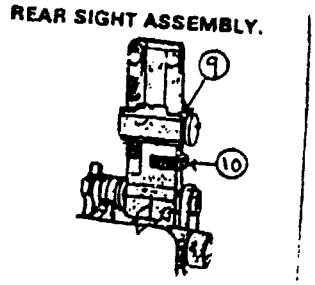
TARGET PRACTICE GAME

Refer to TARGET 2 for this game.

CHIP will present the name of an item.
Press the number shown on the target for
that item, then press GO.

TARGET 2





1) Flash Suppressor
2) Barrel
3) Safety Lever
4) Gas System
5) Bipod (Folded)
6) Barrel Locking Lever
7) Cover Latch
8) Traversing and Elevating Mechanism
9) Rear-Sight Slide
10) Elevation Knob

ROLL CALL

Student may select either "terms" or "definitions" mode. CHIP will present a term (or definition), then three choices of definitions (or terms) one at a time. The student is to press YES while the correct choice is displayed. "Terms" will be spoken as well as displayed.

TERMS/DEFINITIONS

1) Flash Suppressor
   (Helps conceal your gunfire)

2) Cocking Handle
   (Used to pull bolt to rear)

3) Bipod
   (Mount that is fixed to barrel)

4) Tripod
   (Three legged mount)

5) T&E Mechanism
   (For adjusting aiming with tripod)

6) Windage Knob
   (For right-left sighting correction)

7) Slide Release
   (For major sighting change in elevation)

8) Elevation Knob
   (For minor sighting change in elevation)

9) Front Sight
   (Sight that is fixed to the barrel)

10) Rear Sight
   (Sight that can be folded down)